US010053849B2

(12) **United States Patent**
Matsuo et al.

(10) **Patent No.: US 10,053,849 B2**
(45) **Date of Patent: Aug. 21, 2018**

(54) **FLUSH TOILET**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **15/417,445**

(22) Filed: **Jan. 27, 2017**

(65) **Prior Publication Data**

US 2017/0241120 A1 Aug. 24, 2017

(30) **Foreign Application Priority Data**

Feb. 19, 2016 (JP) 2016-030052
Nov. 30, 2016 (JP) 2016-232477

(51) **Int. Cl.**
E03D 11/08 (2006.01)

(52) **U.S. Cl.**
CPC ***E03D 11/08*** (2013.01)

(58) **Field of Classification Search**
CPC E03D 11/08; E03D 1/00
USPC 4/420
See application file for complete search history.

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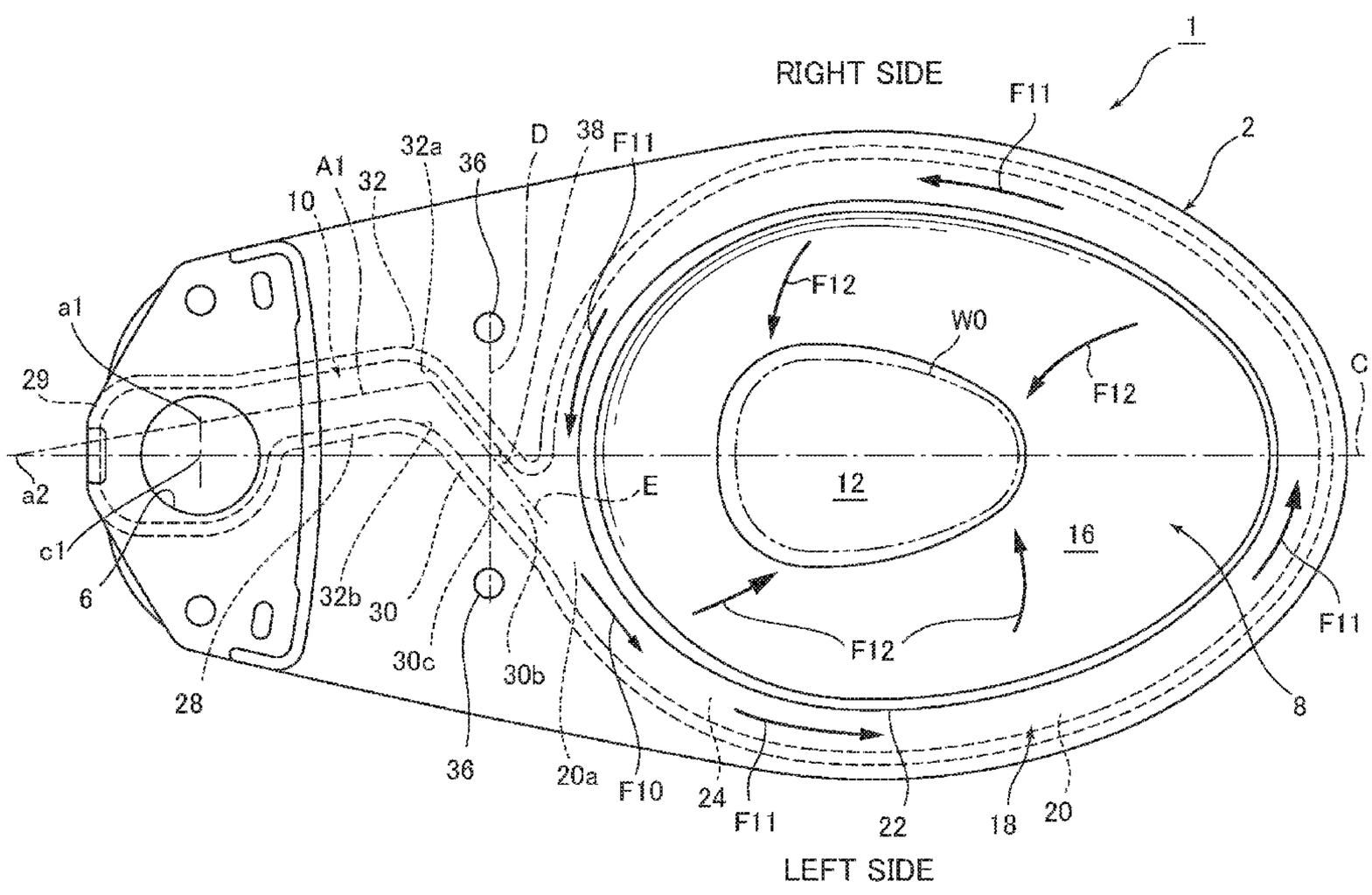
(57) **ABSTRACT**

A flush toilet of the present invention is provided with a toilet main body and a storage tank supplying cleaning water to a supply opening of the toilet main body. The toilet main body includes a bowl, a rim, a rim water passage formed on an entire circumference of the rim, and an aperture formed on the entire circumference of the rim, and a water conduit formed between the supply opening and the rim water passage. The water conduit includes an upstream water conduit extending to the right side from the supply opening, and a downstream water conduit extending to the left side from the upstream water conduit, and the downstream water conduit is formed such that a downstream end of an inner wall surface on the right side is positioned in the left side to a center line of the toilet main body in the left-right direction.

9 Claims, 11 Drawing Sheets



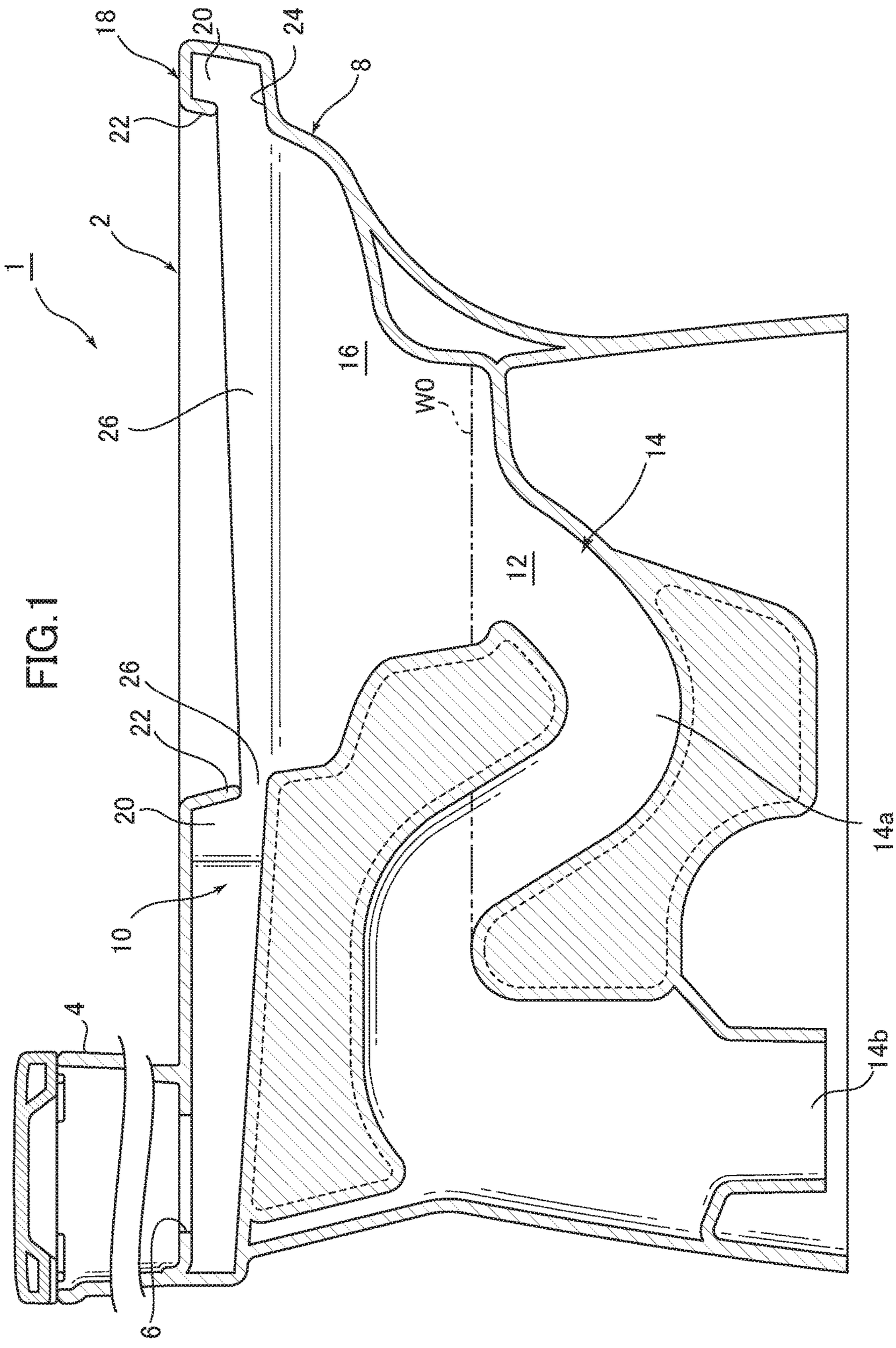
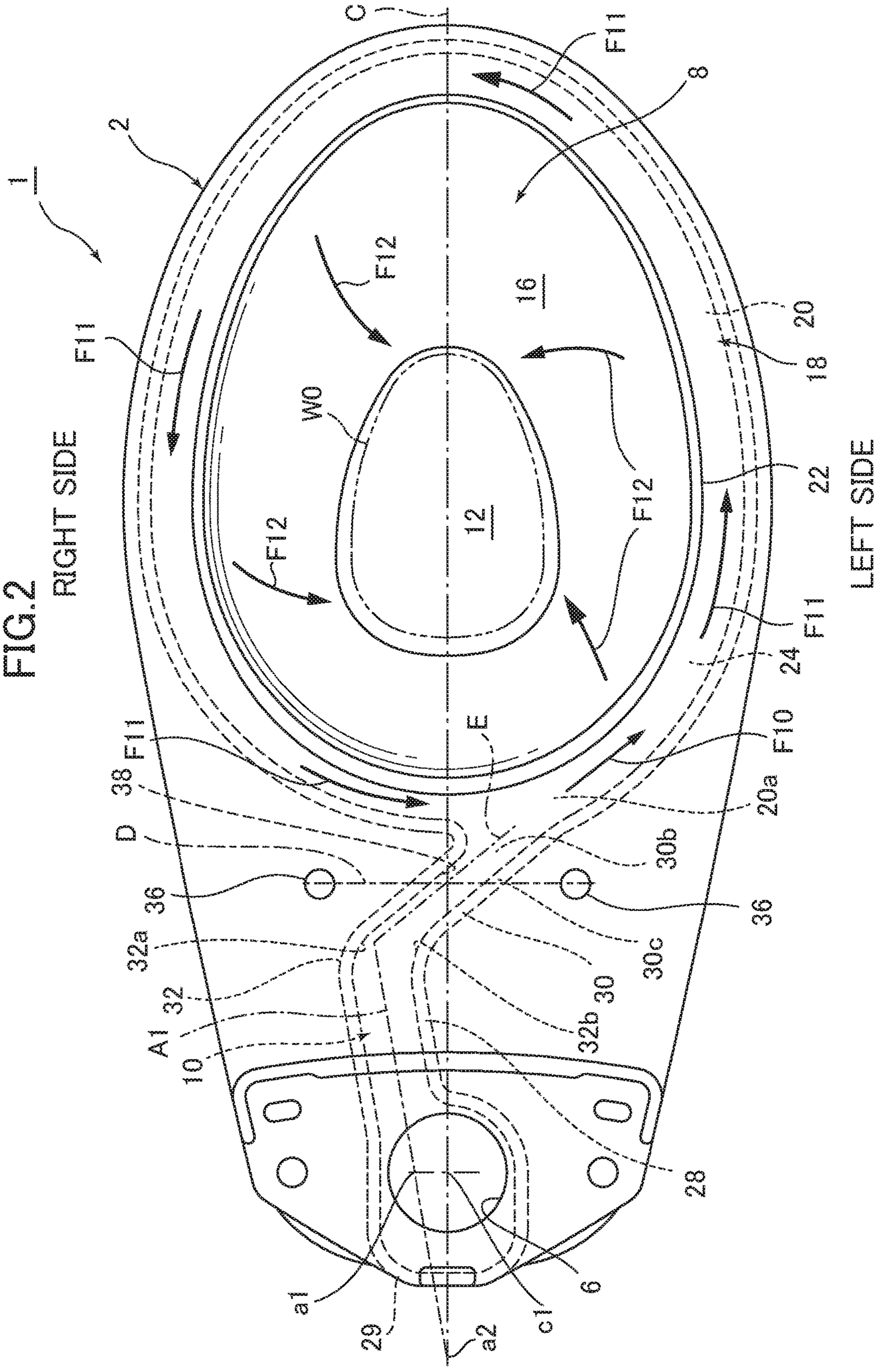


FIG. 1

FIG.2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8
1
F12
16
20
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W0
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LEFT SIDE
RIGHT SIDE
24
F11
E
F10
38
F11
20a
D
30b
36
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30c
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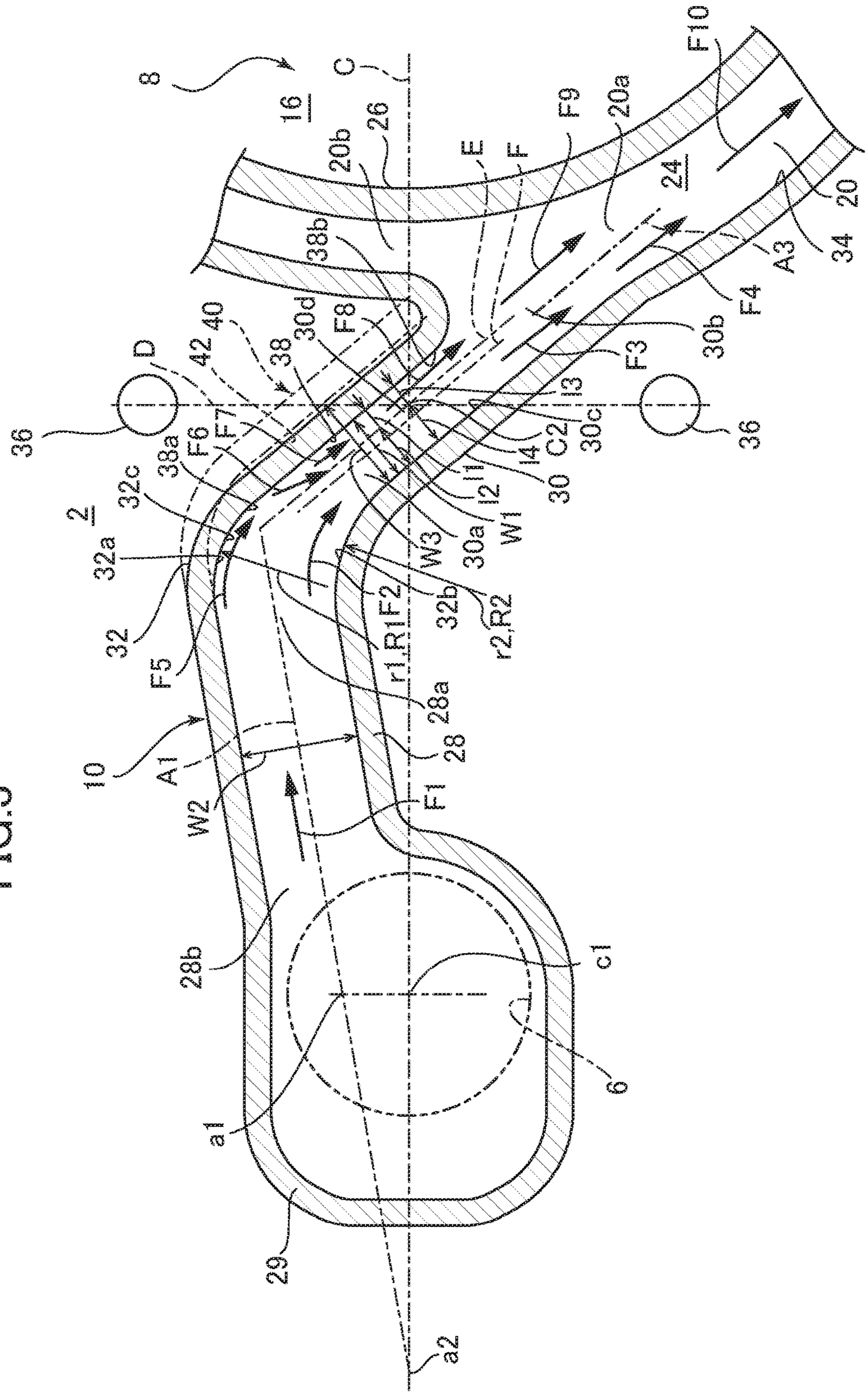
30
A1
32b
10
28
a1
29
a2
c1
6

FIG.3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36
F6
F7
38a
32c
2
32a
32
F5
F3
30b
13
30c
C2
I4
I1
I2
30
W1
W3
30a
32b
r2,R2
r1,R1F2
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F1
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A1
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28b
a1
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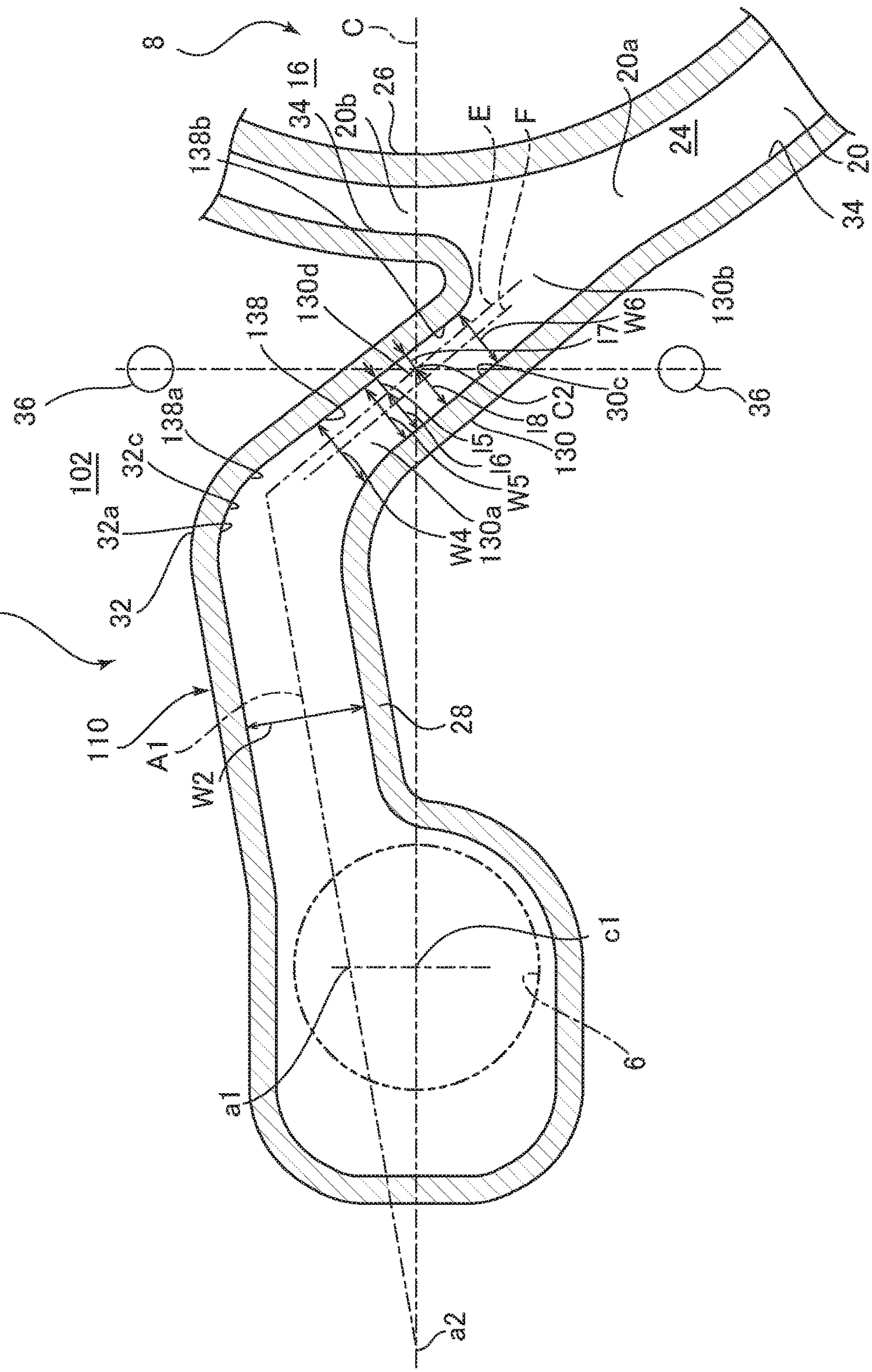
a2
c1
6

FIG.4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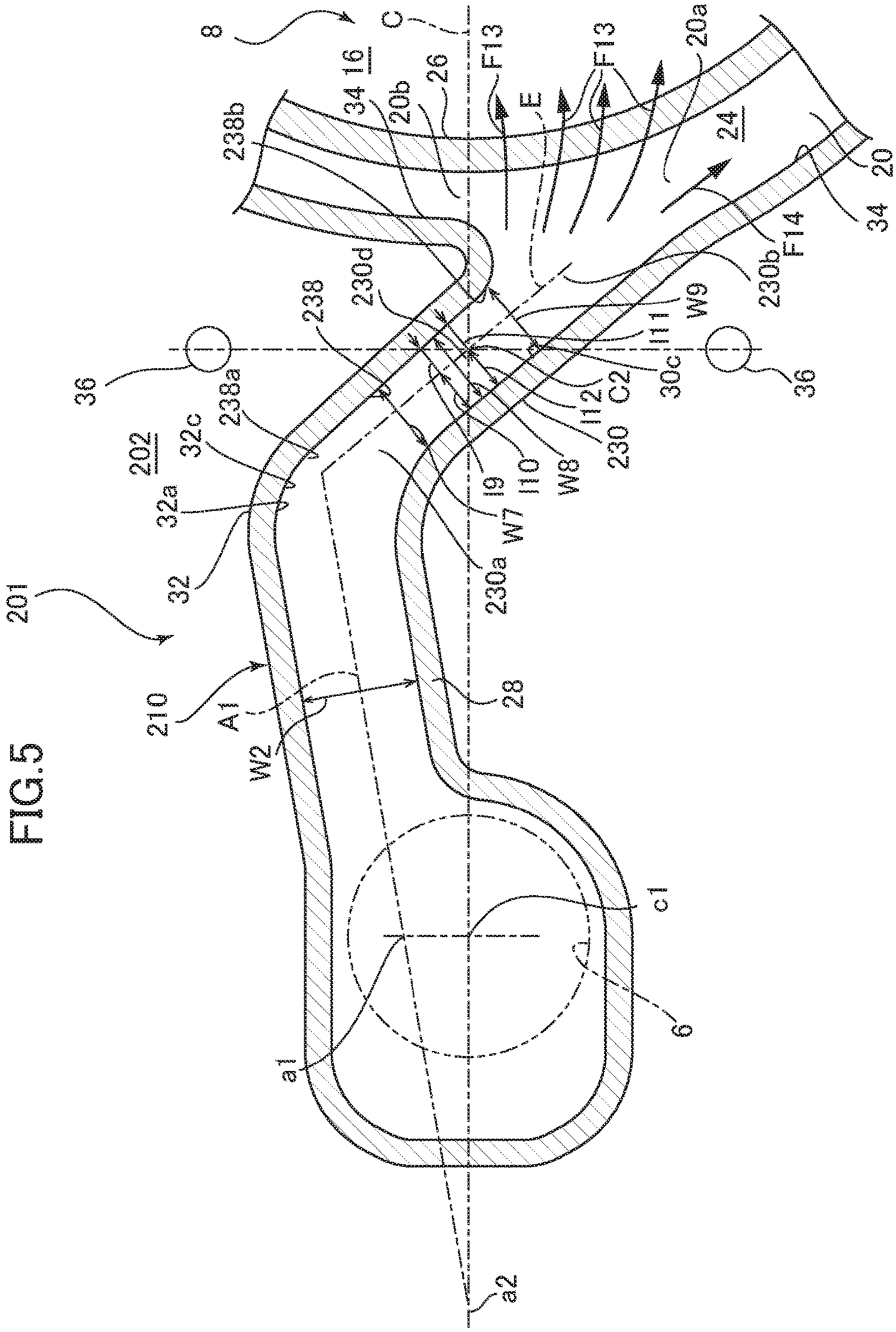
30c
C2
l8
130
l5
l6
W5
130a
W4
138a
32c
102
32a
32
101
110
A1
W2
28
c1
6
a1
a2

FIG.5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230d
238a
32c
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W7
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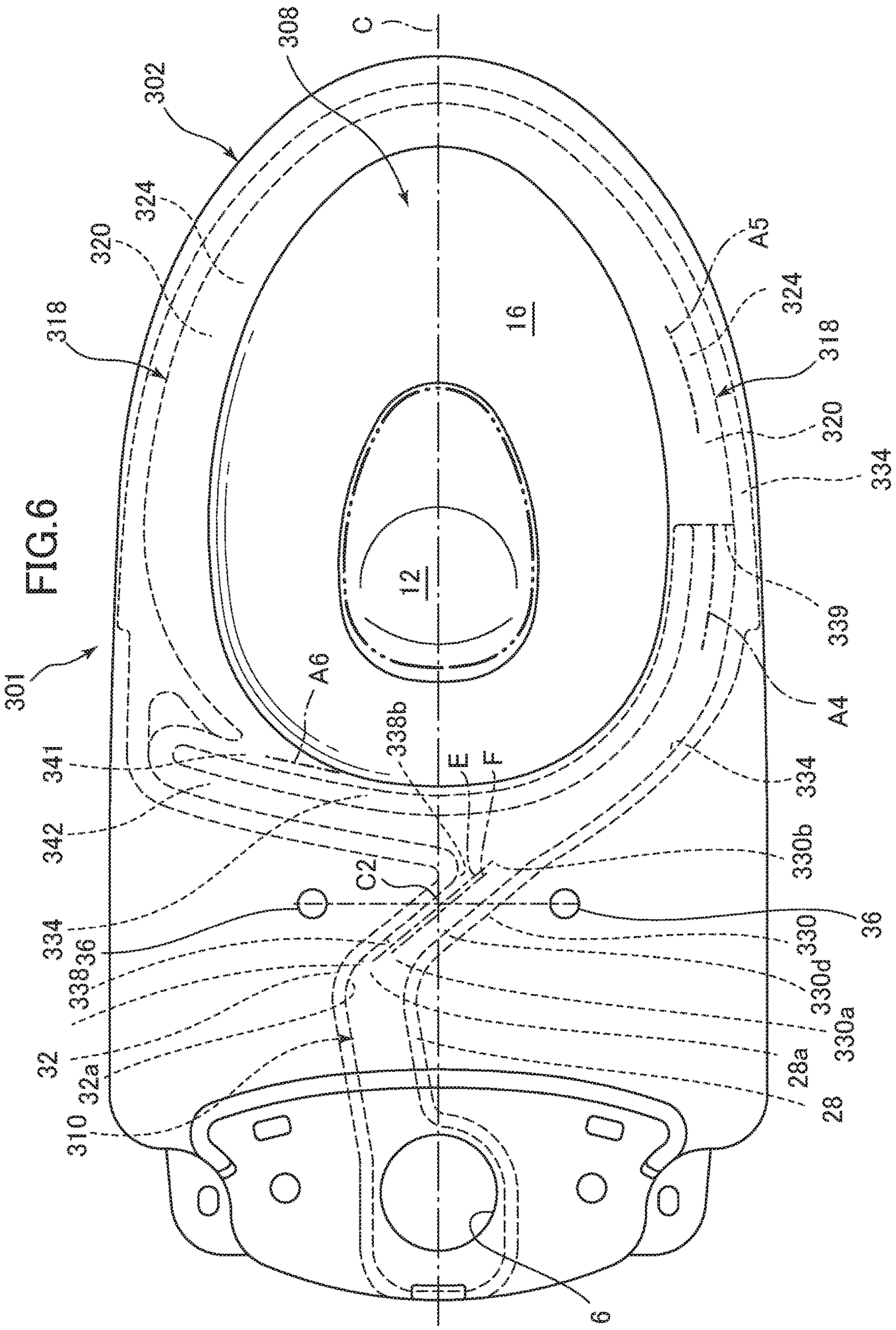
a1
a2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A6
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F
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342
C2
334
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36
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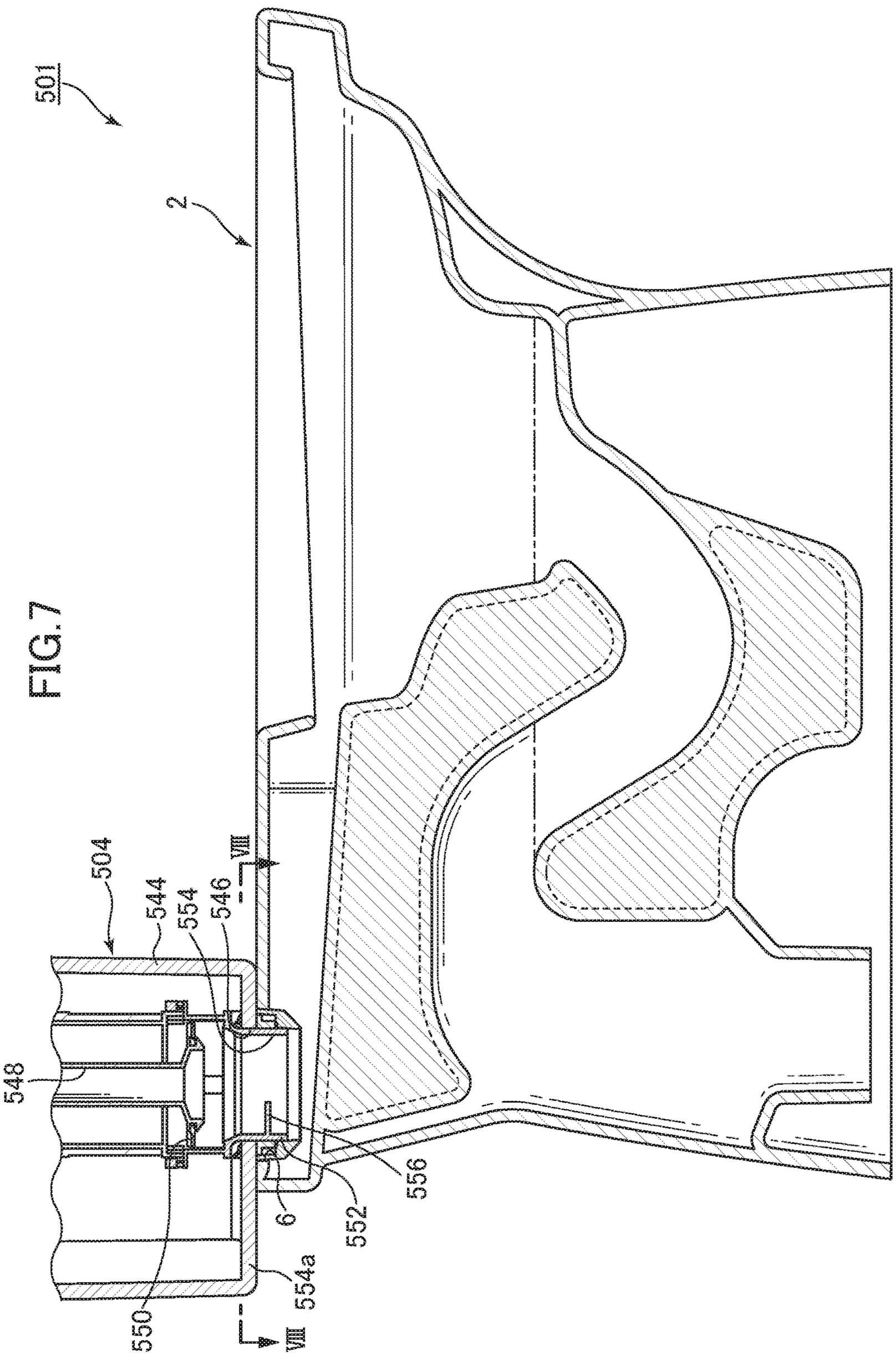
32a
310
301
339
A4
330b
330
330d
330a
28a
28
6

FIG.6

FIG. 7



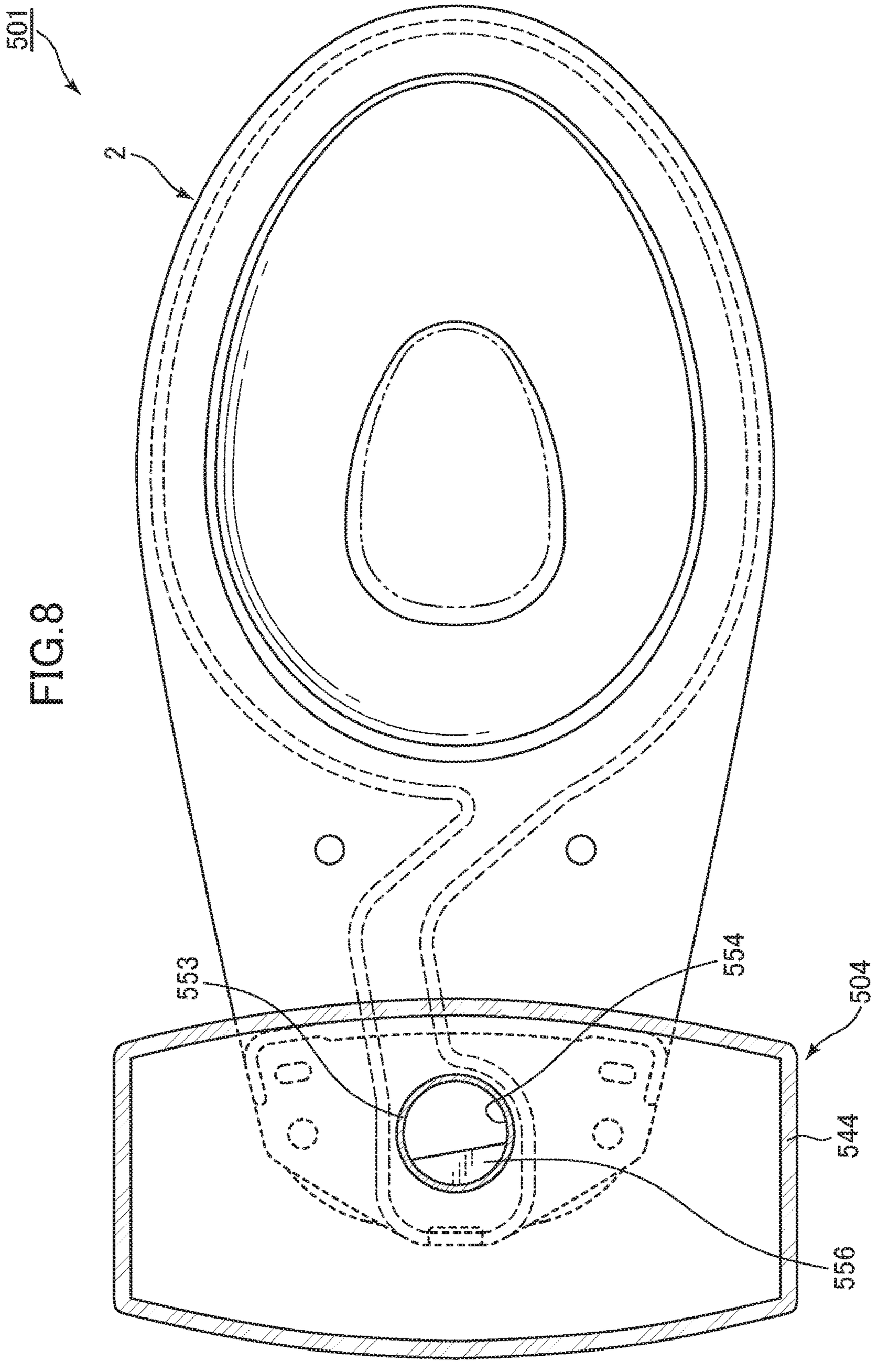
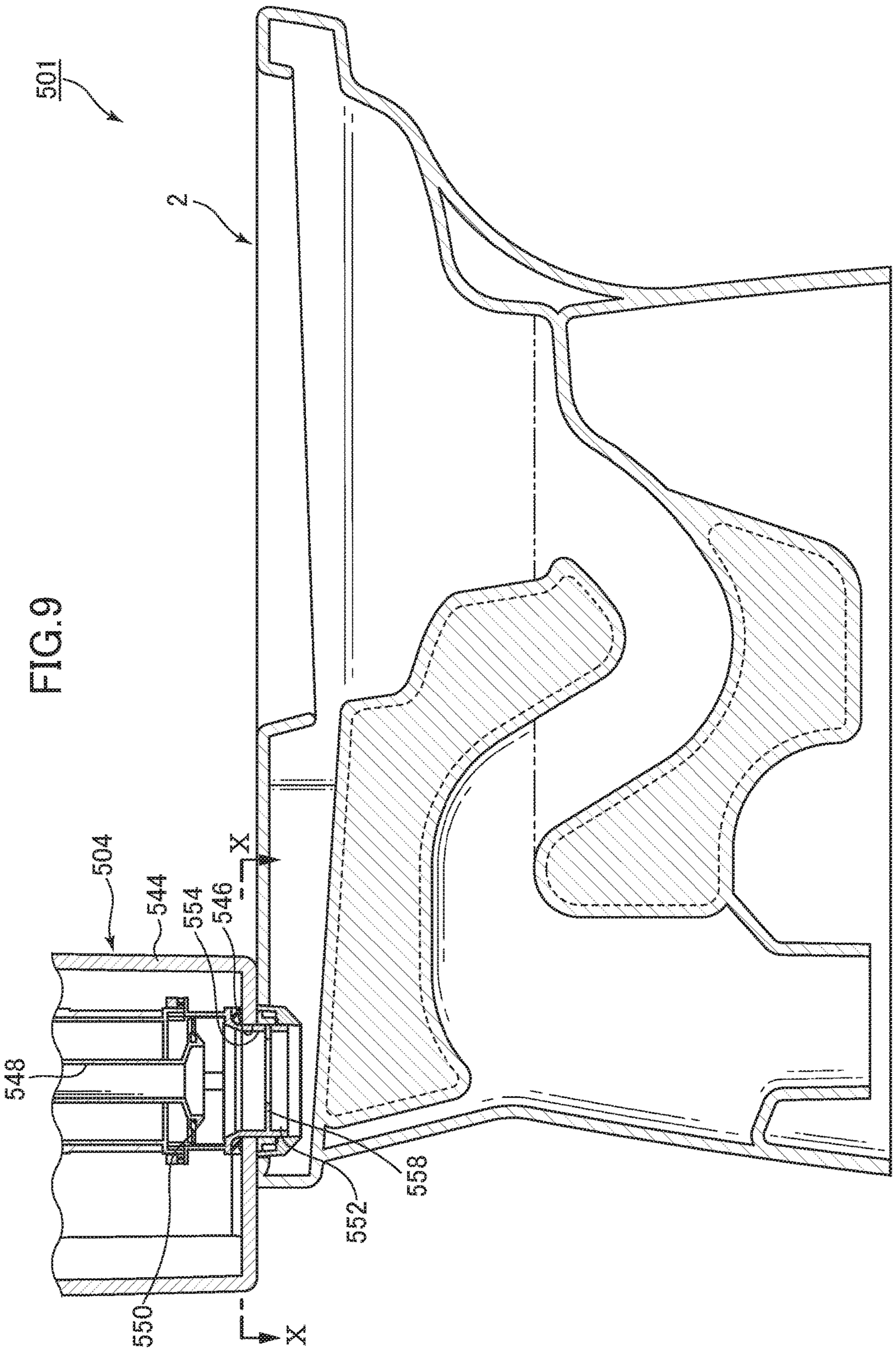


FIG.8

FIG.9



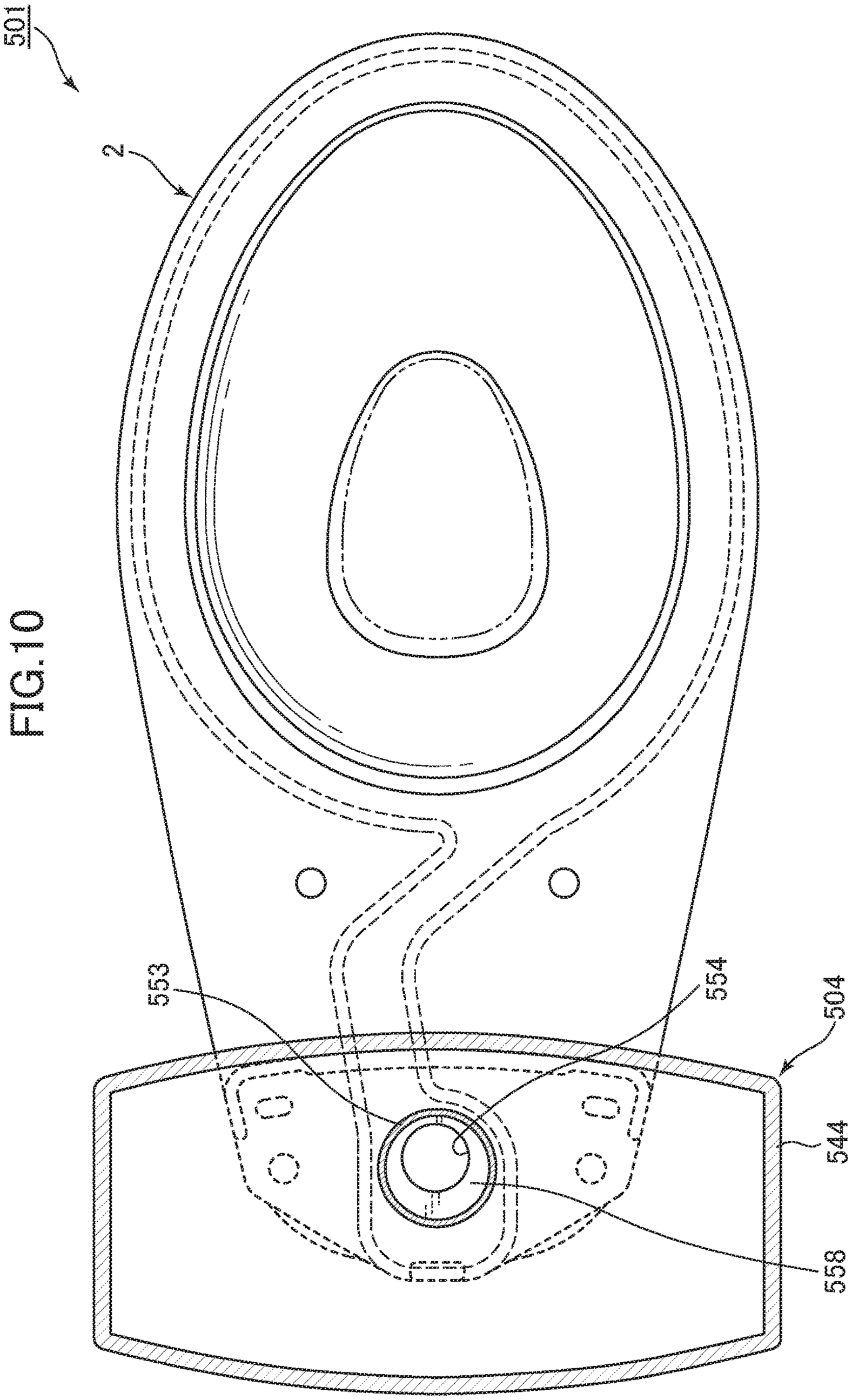


FIG.10

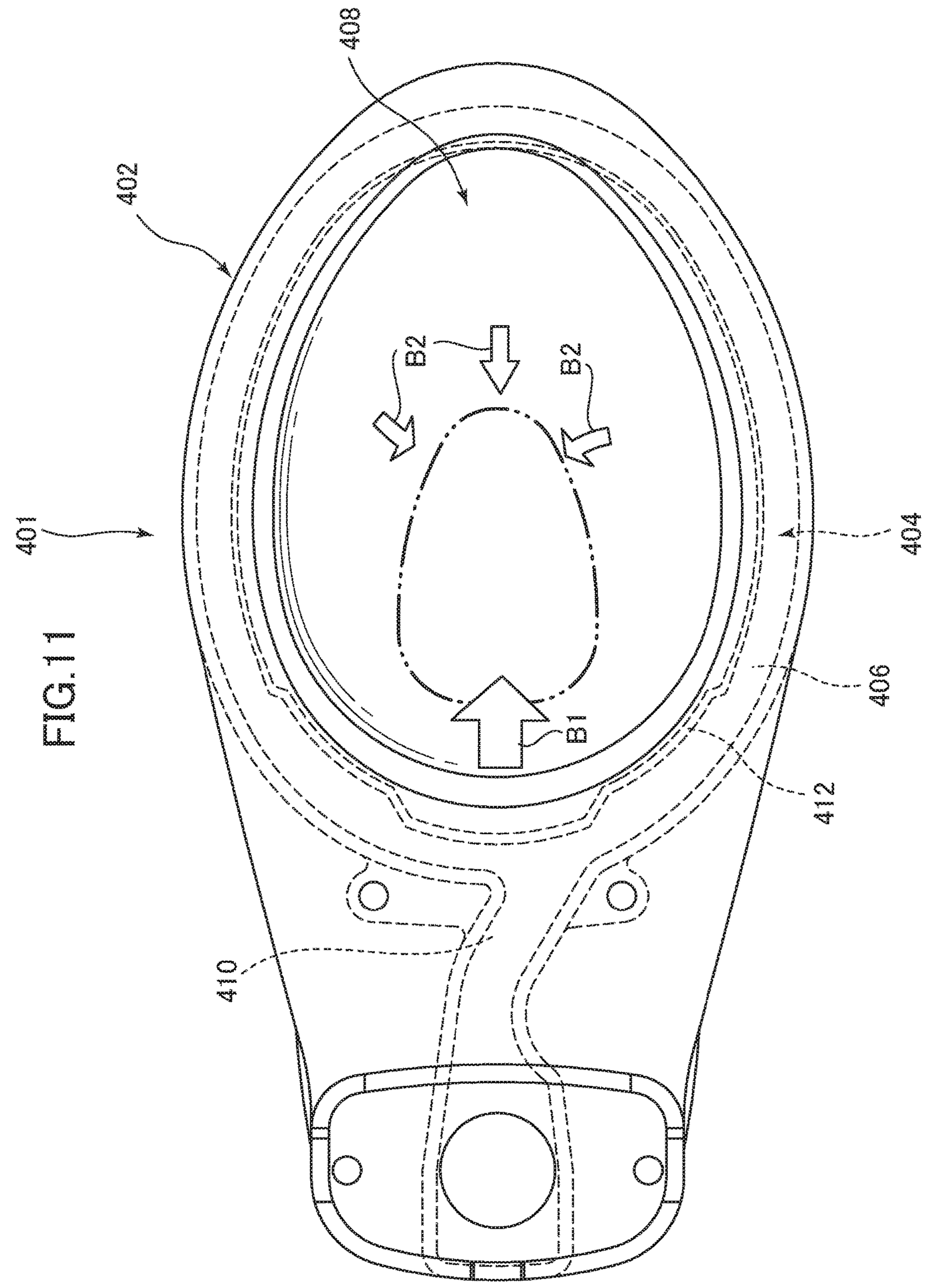


FIG. 11

FLUSH TOILET

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a flush toilet, and particularly, to a flush toilet that cleans a bowl by cleaning water.

Description of the Related Art

There are conventionally known, for example, a conventional flush toilet as shown in Japanese Patent No. 4062731 and a conventional flush toilet **401** having the structure as similar to Japanese Patent No. 4062731 as illustrated in FIG. **11** provided with a so-called open rim structure in which a slit aperture **412** is formed on a bottom surface of a rim water passage **406** in a rim **404** of a toilet main body **402**. In such an open rim structure, an amount of cleaning water flowing down to a bowl **408** from the inside of the rim **404** is adjusted by adjusting a width of the slit aperture **412** between the rim **404** and the bowl **408**.

As illustrated in FIG. **11**, in the flush toilet **401** having the conventional open rim structure in Japanese Patent No. 4062731, a water conduit **410** is connected to the rim water passage **406** in the center vicinity of the toilet main body **402** such that the supplied cleaning water can be divided into a clockwise direction and a counterclockwise direction in the rim water passage **406** to flow therein and clean the bowl **408**.

However, in this conventional flush toilet **401**, when a cleaning water amount for the cleaning is reduced because of a recent demand for economization of water, the momentum of the cleaning water to be supplied to the rim water passage **406** is made weak because of a reduction in cleaning water amount, and a relatively large deal of the cleaning water, as indicated at an arrow B**1**, flows down from the slit aperture **412** to the bowl **408** in a merging portion in the vicinity of an exit in the water conduit **410** in the central, rear side of the toilet main body **402**. As a result, as indicated at an arrow B**2**, the cleaning water that would swirl along the rim water passage **406** becomes insufficient, creating a problem of a defect in the cleaning of the bowl **408**.

Further, even if the cleaning water flowing down from the slit aperture **412** in the vicinity of the exit of the water conduit **410** is designed to be reduced by simply forming the width of the slit aperture **412** to be small, the momentum of the cleaning water that would swirl in the rim water passage **406** cannot be still strengthened, creating a problem that the cleaning water cannot go around in the rim water passage **406**.

In addition thereto, there is a problem that it is difficult to form the width of the slit aperture **412** to be small in view of the manufacture, and therefore the width of the slit aperture **412** cannot be made small.

Further, as illustrated in FIG. **11**, the structure in which the toilet main body **402** turns from the center immediately before the merging portion between the water conduit **410** and the rim water passage **406** is the structure that the supplied cleaning water is originally designed to be divided into a clockwise direction and a counterclockwise direction from the center in the rim water passage **406** to flow over the entire rim water passage **406**. Therefore in a case where the cleaning water amount is reduced, the flow having the stronger momentum cannot be formed, creating a problem that the cleaning water cannot go around in the rim water passage from one side of the left and right sides.

Therefore the present invention is made for solving the foregoing problems in the conventional technology, and an

object of the present invention is to provide a flush toilet in which cleaning water flowing out to a rim water passage from a downstream water conduit in a water conduit of a toilet main body is suppressed from flowing down in a region in the vicinity of a center line of a bowl in a left-right direction, making it possible to sufficiently clean the bowl by an excellent swirl flow of the cleaning water swirling in the rim water passage.

SUMMARY OF THE INVENTION

For achieving the above object, the present invention provides a flush toilet that cleans a bowl by cleaning water, comprising: a toilet main body; and a water supply device that supplies the cleaning water to a supply opening of the toilet main body; the toilet main body including: a bowl having a waste receiving surface having a bowl shape, a rim provided on an upper side of the waste receiving surface, a rim water passage formed on an entire circumference of the rim to introduce the cleaning water, and an aperture formed on the entire circumference of the rim to supply the cleaning water on the waste receiving surface from the rim water passage; a discharge passage an inlet of which is connected to a lower side of the bowl to discharge wastes; and a water conduit formed between the supply opening and the rim water passage to introduce the cleaning water to the rim water passage; wherein the water conduit includes an upstream water conduit extending to one side of the toilet main body in the left-right direction from the supply opening, and a downstream water conduit extending to the other side in the left-right direction from the upstream water conduit, and the downstream water conduit is formed such that a downstream end of an inner wall surface on one side in the left-right direction is positioned in the other side to a center line of the toilet main body in the left-right direction.

In the present invention as thus configured, the cleaning water turns from the upstream water conduit extending to the one side of the toilet main body in the left-right direction, flows into the downstream water conduit, and is introduced to the other side in the left-right direction along the downstream water conduit. The cleaning water flowing along the inner wall surface on the one side of the downstream water conduit in the left-right direction in the cleaning water introduced to the other side in the left-right direction can flow along the inner wall surface to a downstream end portion positioned in the other side to the center line of the toilet main body. Accordingly the cleaning water flowing out from the vicinity of the downstream end portion of the inner wall surface can be suppressed from flowing down in a region of the center line vicinity and form a main flow of the cleaning flow toward the rim water passage from the downstream water conduit. Therefore in the so-called open rim type flush toilet having the aperture formed on the entire circumference of the rim, it is possible to form the excellent swirl flow of the cleaning water to swirl in the rim water passage, and even in a case where the cleaning water amount to be used for toilet cleaning is set to be small, the bowl can be sufficiently cleaned by the swirl flow.

According to the present invention, preferably a width of the downstream water conduit is smaller than a width of the upstream water conduit.

According to the present invention as thus configured, a flow velocity of the cleaning water flowing into the downstream water conduit from the upstream water conduit increases in the downstream water conduit, and the cleaning water flowing out from the vicinity of the downstream end portion of the inner wall surface is suppressed from flowing

to spread out to the region in the center line vicinity. Further, the main flow of the cleaning water toward the rim water passage from the downstream water conduit can be formed, and more excellently it is possible to form the swirl flow of the cleaning water to swirl in the rim water passage.

According to the present invention, preferably a width of the downstream water conduit is made smaller toward an exit of the downstream water conduit from an inlet of the downstream water conduit.

According to the present invention as thus configured, a flow velocity of the cleaning water flowing into the downstream water conduit increases toward the exit of the downstream water conduit from the inlet of the downstream water conduit. Therefore the cleaning water flowing out from the vicinity of the downstream end portion of the inner wall surface is further suppressed from flowing to spread out to the region in the center line vicinity. Further, the main flow of the cleaning water toward the rim water passage from the downstream water conduit can be formed, and more excellently it is possible to form the swirl flow of the cleaning water to swirl in the rim water passage.

According to the present invention, preferably a width of the downstream water conduit is made larger toward an exit of the downstream water conduit from an inlet of the downstream water conduit.

According to the present invention as thus configured, since the width of the downstream water conduit is made larger toward the exit from the inlet, in a case where the water momentum of the cleaning water to be supplied to the supply opening of the toilet main body from the water supply device is made weaker in the latter half of a toilet cleaning operation, the cleaning water flowing out from the exit of the downstream water conduit can form the flow spreading out in a fan shape corresponding to the widening of the width of the downstream water conduit to clean a wide range of the bowl more uniformly.

According to the present invention, preferably a center line of the upstream water conduit extends to be biased to one side in the left-right direction from a center of the supply opening.

According to the present invention as thus configured, since the center line of the upstream water conduit extending to the one side of the toilet main body in the left-right direction from the supply opening extends to be biased to an extension direction of the upstream water conduit in the left-right direction from the center of the supply opening, the cleaning water flowing out from the supply opening can relatively smoothly flow out to the biased upstream water conduit from the extension direction side of the upstream water conduit in the left-right direction from the center of the supply opening. Therefore as compared to a case where the center axis of the upstream water conduit is not biased from the center of the supply opening, the cleaning water can relatively smoothly flow into the upstream water conduit from the supply opening in a side of the biased upstream water conduit.

According to the present invention, preferably the water conduit further includes a bending portion formed between an exit of the upstream water conduit and an inlet of the downstream water conduit, wherein the bending portion is formed such that a curvature radius of an outer circumference wall of a flow passage in the bending portion is smaller than a curvature radius of an inner circumference wall of the flow passage.

In the present invention as thus configured, since the curvature radius of the outer circumference wall of the flow passage in the bending portion is smaller than the curvature radius of the inner circumference wall of the flow passage, the flow along the outer circumference wall of the flow passage in the bending portion can be guided toward the flow along the inner circumference wall of the flow passage in the bending portion, and the momentum of the cleaning water flowing into the rim water passage along the wall surface extending from the inner circumference wall side to the downstream water conduit is strengthened, making it easier to form the flow to swirl in the rim water passage.

According to the present invention, preferably the water supply device includes a storage tank that stores cleaning water, wherein a bottom portion of the storage tank is provided with a discharge opening that supplies the cleaning water to the supply opening of the toilet main body, and the discharge opening of the storage tank is provided with a guiding device that guides the cleaning water to be supplied to the supply opening of the toilet main body to an extension direction of the upstream water conduit.

In the present invention as thus configured, since the discharge opening of the storage tank has the guiding device that guides the cleaning water to be supplied to the supply opening of the toilet main body to the extension direction of the upstream water conduit, the cleaning water flows along the guiding device. Therefore the flow of the cleaning water flowing into the supply opening from the discharge opening can be guided to the upstream water conduit direction. Therefore it can be made easier for the cleaning water supplied to the supply opening to go to the extension direction of the upstream water conduit, more excellently forming the swirl flow of the cleaning water that will swirl in the rim water passage.

According to the present invention, preferably the guiding device is a cylindrical guiding member for connection between the discharge opening and the supply opening, wherein the guiding member is provided with a narrowed portion projecting inside from a part of or an entire circumference of an inner wall of the guiding member such that the cleaning water supplied to the supply opening flows to the extension direction of the upstream water conduit.

In the present invention as thus configured, the guiding device is the cylindrical guiding member for connection between the discharge opening and the supply opening, and since the guiding member is provided with the narrowed portion projecting inside from a part of or an entire circumference of the inner wall of the guiding member such that the cleaning water supplied to the supply opening flows to the extension direction of the upstream water conduit, when the cleaning water entering into the guiding member from the discharge opening flows to the supply opening of the toilet main body, the cleaning water is guided by the guiding member, and a large part of the cleaning water goes to the extension direction of the upstream water conduit. Therefore it is possible to create the flow of the cleaning water going to the extension direction of the upstream water conduit, more excellently forming the swirl flow of the cleaning water that will swirl in the rim water passage.

Further, the present invention provides a flush toilet that cleans a bowl by cleaning water, comprising: a toilet main body; and a water supply device that supplies the cleaning water to a supply opening of a toilet main body; the toilet main body including a bowl having a waste receiving surface having a bowl shape, a rim provided on an upper edge portion of the bowl, a rim water passage formed on an inner circumference of the rim to introduce the cleaning water, and a spout portion opening on the rim water passage and spouting the cleaning water to the rim water passage; a discharge passage connected to a lower side of the bowl to

discharge wastes; and a water conduit formed between the supply opening and the spout portion to introduce the cleaning water to the spout portion, wherein the water conduit includes an upstream water conduit extending to one side of the toilet main body in the left-right direction from the supply opening, and a downstream water conduit extending to the other side in the left-right direction from the upstream water conduit, and the downstream water conduit is formed such that a downstream end of an inner wall surface on one side in the left-right direction is positioned in the other side to a center line of the toilet main body in the left-right direction.

In the present invention as thus configured, the cleaning water turns from the upstream water conduit extending to the one side of the toilet main body in the left-right direction, flows to the downstream water conduit, and is introduced to the other side in the left-right direction along the downstream water conduit. The cleaning water flowing along the inner wall surface on the one side of the downstream water conduit in the left-right direction in the cleaning water introduced to the other side in the left-right direction can flow along the inner wall surface to the downstream end portion positioned in the other side to the center line of the toilet main body. Accordingly the cleaning water flowing out from the vicinity of the downstream end portion of the inner wall surface can form a main flow of the cleaning water toward the spout portion from the downstream water conduit. Therefore in the so-called non-brim type flush toilet, the cleaning water spouted from the spout portion can form the excellent swirl flow of the cleaning water to swirl on the waste receiving surface, and even in a case where the cleaning water amount to be used for toilet cleaning is set to be small, the bowl can be sufficiently cleaned by the swirl flow.

According to the flush toilet of the present invention, the cleaning water flowing out to the rim water passage from the downstream water conduit in the water conduit of the toilet main body can be suppressed from flowing down in the region in the vicinity of the center line of the bowl in the left-right direction, making it possible to sufficiently clean the bowl by an excellent swirl flow of the cleaning water swirling in the rim water passage.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a side cross section illustrating a flush toilet according to a first embodiment of the present invention;

FIG. **2** is a plan view of a toilet main body in the flush toilet according to the first embodiment of the present invention;

FIG. **3** is a schematic partial enlarged view illustrating a flow passage in a rear upper portion of the toilet main body in the flush toilet according to the first embodiment of the present invention by a horizontal cross-section plane;

FIG. **4** is a schematic partial enlarged view illustrating a flow passage in a rear upper portion of a toilet main body in a flush toilet according to a second embodiment of the present invention by a horizontal cross-section plane;

FIG. **5** is a schematic partial enlarged view illustrating a flow passage in a rear upper portion of a toilet main body in a flush toilet according to a third embodiment of the present invention by a horizontal cross-section plane;

FIG. **6** is a schematic partial enlarged view illustrating a flow passage in a rear upper portion of a toilet main body in a flush toilet according to a fourth embodiment of the present invention;

FIG. **7** is a side cross section illustrating a flush toilet according to a fifth embodiment of the present invention;

FIG. **8** is a plan cross section as viewed along line VIII-VIII in FIG. **8**;

FIG. **9** is a side cross section illustrating a flush toilet provided with a modification of a cleaning water guiding member according to the fifth embodiment of the present invention;

FIG. **10** is a plan cross section as viewed along line X-X in FIG. **9**; and

FIG. **11** is a plan view illustrating a toilet main body of a conventional flush toilet.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Hereinafter, an explanation will be made of a flush toilet according to embodiments of the present invention with reference to the accompanying drawings.

First, an explanation will be made of a flush toilet according to a first embodiment of the present invention with reference to FIG. **1** to FIG. **3**.

As illustrated in FIG. **1** to FIG. **3**, a flush toilet **1** according to the first embodiment of the present invention has a toilet main body **2** formed of a pottery. A storage tank **4** as a water supply device is mounted on an upper side of the toilet main body **2** in the backside.

Here, a cleaning water amount to be supplied from the storage tank **4** is in a range of 3 L to 6.5 L, preferably in a range of 3.8 L to 6.5 L, more preferably in a range of 4.8 L to 6 L.

The water supply device is not only the storage tank but also may be a flush valve or the like that can supply a prescribed cleaning water amount.

A bowl **8** is formed on the front upper portion of the toilet main body **2**, and a supply opening **6** to which the cleaning water is supplied from the storage tank **4** is formed on the rear upper portion of the toilet main body **2**, and further, a water conduit **10** introducing the cleaning water to the bowl **8** from the supply opening **6** is formed thereupon. The supply opening **6** is arranged substantially in the center of the toilet main body **2** as viewed from the front side of the toilet main body **2**.

Further, a pooled water portion **12** is formed in the lower side of the bowl **8**, and pooled water having a pooled water plane in an initial water level indicated at W**0** is stored in the pooled water portion **12**. An inlet **14***a* of a discharge trap conduit **14** (discharge passage) is connected to the lower end of the pooled water portion **12**, and the discharge trap conduit **14** extends backward from the inlet **14***a* and a rear end **14***b* thereof is connected to a discharge conduit (unillustrated) installed on a floor surface.

The bowl **8** includes the waste receiving surface **16** formed in a bowl shape, and a rim **18** that is formed on an upper side thereof to spout cleaning water on the waste receiving surface **16**. The rim **18** is provided with a rim drooping wall **22** extending to droop to the vicinity of the waste receiving surface **16** downward from the upper surface, and a rim water passage **20** is formed in the inside (outside as viewed from the center of the toilet main body) of the rim **18** by the rim drooping wall **22**.

The rim **18** is provided with a slit aperture **26** that is formed therein and by which the inside and lower side of the rim water passage **20** formed along the circumferential direction of the rim **18** is opened over the entire circumfer-

ence, configuring a so-called open rim. The slit aperture **26** forms a spout portion that spouts the cleaning water on the waste receiving surface **16**.

The bowl **8** is provided with a rim water passage bottom surface **24** in a shelf shape formed over substantially the entire circumference of the bowl **8** between the waste receiving surface **16** and the rim **18**. The rim water passage bottom surface **24** forms a flat surface formed annularly on the upper portion of the bowl **8**, and the flat surface is formed substantially horizontally in the inner direction from the outer direction of the bowl **8**.

With the rim water passage bottom surface **24**, the cleaning water supplied from the water conduit **10** flows on the rim water passage bottom surface **24** in the rim water passage **20** and can form the flow going around in a counterclockwise direction on the upper portion of the bowl **8**.

Next, the details of the water conduit **10** will be described. As illustrated in FIG. **1** and FIG. **2**, the supply opening **6** to which the aforementioned storage tank **4** is connected is formed on the rear end of the water conduit **10** in the toilet main body **2**, and the cleaning water supplied from the storage tank **4** flows into the water conduit **10** of the toilet main body **2** from the supply opening **6** and flows out to the rim water passage **20** from the water conduit **10**.

As illustrated in FIG. **2** and FIG. **3**, the water conduit **10** includes an upstream water conduit **28** extending to the right side (one side) of the toilet main body **2** in the left-right direction from the supply opening **6**, and a downstream water conduit **30** extending to the left side (the other side) from the upstream water conduit **28** in the left-right direction. The water conduit **10** forms a flow passage bilaterally non-symmetric about a center line C of the toilet main body **2** in the left-right direction. The water conduit **10** forms a flow passage in a V shape by the upstream water conduit **28** and the downstream water conduit **30**. The upstream water conduit **28** and the downstream water conduit **30** are connected by a bending portion **32**, and the bending portion **32** is positioned in the right region to the center line C of the toilet main body **2**.

The upstream water conduit **28** extends linearly toward the oblique right direction from an inlet **28***b* lying right downstream of the supply opening **6** positioned on the center line C of the toilet main body **2** in the left-right direction and extends to an exit **28***a* arranged in the right side to the center line C. The upstream water conduit **28** is arranged such that the front side of the center line **A1** is inclined right outward to the center line C.

As illustrated in FIG. **2** and FIG. **3**, the supply opening **6** is arranged such that a center point **c1** is positioned on the center line C of the toilet main body **2** in the left-right direction. The upstream water conduit **28** is formed such that the center line **A1** is biased in the right direction to the center line C of the toilet main body **2**. The center line **A1** of the upstream water conduit **28** extends to be biased passing a position a**1** on the right side of a center point **c1** of the supply opening **6** and the center line C of the toilet main body **2**.

The center line **A1** of the upstream water conduit **28** extends to be biased to the right side to the center line C from the inlet **28***b* to the exit **28***a*. When the center line **A1** extends backward, the center line **A1** intersects with the center line C in a position a**2** in back of the center point **c1** of the supply opening **6**.

The inlet **28***b* of the upstream water conduit **28** is connected in a position shifted in the right side to the center line C of a wall surface **29** of the outer circumference in the supply opening **6**.

The bending portion **32** is formed as a bent flow passage for connection between the exit **28***a* of the upstream water conduit **28** and an inlet **30***a* of the downstream water conduit **30**. The bending portion **32** includes an outer circumference wall **32***a* formed on an outer side in the flow passage of the bending portion **32** (outer side of the toilet main body **2**) and an inner circumference wall **32***b* formed on an inner side in the flow passage of the bending portion **32**.

Here, a curvature radius **r1** of the outer circumference wall **32***a* in the bending portion **32** is smaller than a curvature radius **r2** of the inner circumference wall **32***b*.

The bending portion **32** is formed such that a ratio in magnitude between the curvature radius **r1** of the outer circumference wall **32***a* and the curvature radius **r2** of the inner circumference wall **32***b* is set in a range of a ratio of 1:2 to a ratio of 4:5. As an example, a ratio in magnitude between the curvature radius **r1** of the outer circumference wall **32***a* and the curvature radius **r2** of the inner circumference wall **32***b* is set to a ratio of 3:4.

The downstream water conduit **30** forms a path that extends to the left side from the inlet **30***a* and leads to the exit **30***b*, which is connected to a merging portion **20***a* of the rim water passage **20**. The merging portion **20***a* is arranged in a left rear portion of the rim water passage **20**. In the merging portion **20***a*, the flow of the cleaning water flowing out from the exit **30***b* of the downstream water conduit **30** and the flow of the cleaning water returning back after going around in the rim water passage **20** merge.

The downstream water conduit **30** forms a linear flow passage obliquely crossing the center line C of the toilet main body **2** to the left from the right from the inlet **30***a* to the exit **30***b*.

The downstream water conduit **30** has the inlet **30***a* arranged in the right region to the center line C, an intermediate portion **30***d* arranged in the vicinity of the center line C and the exit **30***b* arranged in the left region to the center line C. As a result, the downstream water conduit **30** forms a relatively long flow passage that goes over the center line C from the right side of the center line C and extends to a region of the left rear portion of the bowl **8**. Since the downstream water conduit inlet **30***a* is arranged in the right side to the center line C, a length from the inlet **30***a* to the exit **30***b* positioned in the left rear region of the bowl **8** is set to a relatively long length. Since the downstream water conduit **30** has the flow passage having the relatively long length, the cleaning water can be appropriately adjusted in flow in the downstream water conduit **30**, is enhanced the directivity of the cleaning water, and is spouted by the flow adjusted in the direction of going around on the rim water passage **20** from the exit **30***b* of the downstream water conduit **30** and by the flow in a relatively strong water momentum state.

In a region in which the downstream water conduit **30** and the rim water passage **20** are connected, an outer wall surface **30***c* of the downstream water conduit **30** and a rim water passage outer wall surface **34** of the rim **18** are successively formed in a substantially flat shape. That is, the outer wall surface **30***c* and the rim water passage outer wall surface **34** are formed to be flush in the connection portion vicinity, and an extension direction of the outer wall surface **30***c* substantially corresponds to a tangential direction of the rim water passage outer wall surface **34**. Accordingly the cleaning water can smoothly flow along the flat surface linearly extending from the outer wall surface **30***c* of the downstream water conduit **30** to the rim water passage outer wall surface **34** of the rim **18**, and suppress a pressure loss of the flow flowing along the outer wall surface **30***c*.

The inner wall surface **38** of the downstream water conduit **30** in the right side extends to the left side of the center line C from the right side of the center line C of the toilet main body **2**.

The inner wall surface **38** forms the inlet **30***a* of the downstream water conduit **30**, forms an upstream end portion **38***a* connected to a downstream end portion **32***c* of the outer circumference wall **32***a*, the exit **30***b* of the downstream water conduit **30**, and forms a downstream end portion **38***b* positioned in the left side to the center line C. Accordingly the inner wall surface **38** extends to go over the center line C from the right side to the left side of the center line C.

The downstream end portion **38***b* of the inner wall surface **38** in the downstream water conduit **30** forms a convex portion projecting to the left side to the center line C. The downstream end portion **38***b* of the inner wall surface **38** is connected to the rim water passage outer wall surface **34** extending from the rear side of the waste receiving surface **16** in the left region to the center line C.

Since the downstream end portion **38***b* forms the convex portion projecting to the left side to the center line C, the downstream end portion **38***b* sections the flow passage of the downstream water conduit **30** from the center rear region **20***b* of the rim water passage **20**.

Here, the inner wall surface **38** in the downstream water conduit **30** is formed closer to a virtual center line E (shown in a virtual line in FIG. **3**), which will be described later, of the downstream water conduit **30**. At this time, the outer wall surface **30***c* in the downstream water conduit **30** is not closer to the virtual center line E.

The virtual center line E, as illustrated in FIG. **3**, is a center line of the flow passage in a virtual downstream conduit **40** and extends in parallel to an extension direction of the virtual downstream conduit **40**, and is a virtual center line between a virtual inner wall surface **42** and the outer wall surface **30***c*.

An explanation will be made of a state in which the inner wall surface **38** in the downstream water conduit **30** is "closer" to the virtual center line E and the outer wall surface **30***c* and a shape of the inner wall surface **38**.

The virtual downstream conduit **40** having substantially the same width as the upstream water conduit **28** is assumed to the downstream water conduit **30**. The virtual downstream conduit **40** is provided with the virtual inner wall surface **42** in the right side of the virtual downstream conduit **40** in the left-right direction.

This virtual downstream conduit **40** is connected to the downstream side of the upstream water conduit **28** and the bending portion **32**, and is arranged such that the virtual center line E of the virtual downstream conduit **40** passes an intersection point C**2** between the center line C and an attaching position line D connecting attaching portions **36** positioned in both sides of the center line C in the left-right direction. In such a virtual downstream conduit **40**, the virtual center line E is arranged in the center of the virtual inner wall surface **42** and the outer wall surface **30***c*, and the virtual inner wall surface **42** and the outer wall surface **30***c* are arranged in symmetric about the virtual center line E.

By moving the virtual inner wall surface **42** closer to the virtual center line E of the virtual downstream conduit **40**, for example, by parallel movement, the inner wall surface **38** of the downstream water conduit **30** is formed. Therefore a width W**1** of the downstream water conduit **30** is smaller than a width W**2** of the upstream water conduit **28**. The width W**1** of the downstream water conduit **30** is smaller than, and approximately three-fourths of, a width W**3** of the virtual downstream conduit **40**. Therefore a distance **11** from the virtual center line E connecting a point of the upstream water conduit **28** on the center line A**1** and the intersection point C**2** to the inner wall surface **38** is shorter than a distance **12** from the virtual center line E to the outer wall surface **30***c*. A distance **13** from the intersection point C**2** to the inner wall surface **38** is shorter than a distance **14** from the intersection point C**2** to the outer wall surface **30***c*.

The downstream water conduit **30** is formed such that the W**1** between the inner wall surface **38** and the outer wall surface **30***c* is substantially constant. Therefore the width of the downstream water conduit **30** is substantially constant from the inlet **30***a*, through the intermediate portion **30***d* and to the exit **30***b* of the downstream water conduit **30**.

In this way, the inner wall surface **38** and the outer wall surface **30***c* are formed to be non-symmetric about the virtual center line E. As described above, since the inner wall surface **38** is closer to the virtual center line E, an actual center line F as an actual center line of the downstream water conduit **30** is closer to the outer wall surface **30***c*-side than the virtual center line E. Therefore the actual center line F intersects with the attaching position line D in a region in the left side to the intersection point C**2**.

When the inner wall surface **38** of the downstream water conduit **30** is closer to the outer wall surface **30***c*, the downstream end portion **38***b* of the inner wall surface **38** is positioned in a region in the left side to the center line C.

The actual center line F of the downstream water conduit **30** is arranged such that the front side is inclined in a left outer direction to the center line C. An intersection point between the center line A**1** of the upstream water conduit **28** and the actual center line F of the downstream water conduit **30** is positioned in the right side to the center line C, and the downstream water conduit exit **30***b* is positioned in the left side to the center line C. The downstream water conduit **30** and the upstream water conduit **28** are arranged such that an angle between the center line A**1** and the center line C is smaller than an angle between the virtual center line E (or the actual center line F) and the center line C. For example, the virtual center line E has an angle in a range of 30° to 70°, preferably 40° to 60° to the center line C.

The downstream water conduit **30** forms such a flow passage that a part thereof is in parallel to at least a part of a flow passage in the merging portion **20***a* of the rim water passage **20**.

The inner wall surface **38** of the downstream water conduit **30** is formed with such an inclination that a straight line extending along the inner wall surface **38** extends on the rim water passage **20**.

As a result, in the vicinity of the exit **30***b* of the downstream water conduit **30**, a direction of the actual center line F of the downstream water conduit **30** substantially corresponds to a direction of a flow line A**3** of the cleaning water going around on the rim water passage **20** in the merging portion **20***a*. Therefore the cleaning water flowing out from the exit **30***b* of the downstream water conduit **30** flows toward substantially the same swirling direction (counter-clockwise direction) on the rim water passage **20**, making it possible to form a main flow going around on the rim water passage **20** in a state of holding the water momentum (state of substantially maintaining the flow amount and flow velocity). Accordingly it is possible to suppress the cleaning water merging in the merging portion **20***a* of the rim water passage **20** from the downstream water conduit **30** from passing and flowing on the rim water passage **20** toward the reverse swirling direction to the direction of the main flow on the rim water passage **20** and further, from flowing to

spread out toward the center rear region **20***b*-side to flow down on the waste receiving surface **16** from the slit aperture **26**.

The toilet main body **2** has the attaching portions **36** for attaching a toilet seat on the toilet main body **2**. The attaching portions **36** are provided in positions of the vicinity in both sides in the left and right of the toilet main body **2** in back of the rim water passage **20**. Since the attaching portion **36** forms the attachment structure toward the inside of the toilet main body **2**, the downstream water conduit **30** cannot be formed in a position of forming the attaching portion **36**. The downstream water conduit **30** is formed between the attaching portions **36** in both sides in the left and right, therefore making it possible to provide the downstream water conduit **30** to avoid the attaching portions **36** and further, the flow passage in a relatively long length is formed. Here, a virtual straight line for connection between the attaching portions **36** of both sides in the left and right is defined as the attaching position line D. The attaching position line D extends in the left-right direction of the toilet main body **2** to be perpendicular to the center line C. The downstream water conduit **30** is arranged to obliquely intersect with the attaching position line D in a range of an angle larger than 0° and smaller than 90°.

Next, an explanation will be made of a function (operation) of the flush toilet according to the first embodiment of the present invention as described above.

First, when an operating lever (unillustrated) of the storage tank **4** is operated, a discharge valve (unillustrated) in the storage tank **4** opens, and the cleaning water (for example, 6.0 L) is supplied to the water conduit **10** through the supply opening **6** of the toilet main body **2** from the storage tank **4**.

The cleaning water supplied to the supply opening **6** of the toilet main body **2** from the storage tank **4**, as indicated at an arrow F**1**, flows into the upstream water conduit **28** from the right side to which the upstream water conduit **28** is biased. The cleaning water flowing into the upstream water conduit **28** flows to be gradually biased to the right side. That is, the cleaning water flows toward the right side to be away from the center axis line C. When the cleaning water reaches the exit **28***a* of the upstream water conduit **28**, the cleaning water turns in the bending portion **32**. That is, the cleaning water turns from the flow of the right direction to the flow of the left direction of the toilet main body **2**.

On the inner circumference side of the bending portion **32**, the cleaning water, as indicated at an arrow F**2**, flows along the inner circumference wall **32***b* having a relatively large curvature radius r**2**. The cleaning water further flows along the outer wall surface **30***c*, merges with a water flow F**6** of the cleaning water to be described later, and as indicated at arrows F**3** and F**4**, flows toward the rim water passage **20** along the outer wall surface **30***c* of the downstream water conduit **30** from the inner circumference wall **32***b*-side.

On the outer circumference side of the bending portion **32**, the cleaning water, as indicated at an arrow F**5**, turns along the outer circumference wall **32***a* having a relatively small curvature radius r**1** and flows to the inner direction to bounce back. At this time, the cleaning water turns relatively largely along an arc having a small curvature radius of the outer circumference wall **32***a* and, as indicated at F**6**, flows in a direction of the outer wall surface **30***c* of the downstream water conduit **30**. Since the curvature radius r**1** of the outer circumference wall **32***a* is relatively small, a main flow of the cleaning water flowing along the outer circumference wall **32***a* can be separated from the inner wall surface **38** to be directed toward a direction of the outer wall surface **30***c*. Further, a percentage of a flow F**7** flowing along the inner wall surface **38** lying downstream of the outer circumference wall **32***a* is relatively suppressed and the flows F**3** and F**4** flowing along the outer wall surface **30***c* of the downstream water conduit **30** are used as a main flow, making it possible to relatively strongly form the momentum of the cleaning water flowing into the rim water passage **20**.

In this way, the cleaning water, as indicated at the arrows F**3** and F**4**, becomes a linear flow toward the exit **30***b* from the inlet **30***a* of the downstream water conduit **30** along the linearly extending downstream water conduit **30**. The cleaning water linearly flows over the center line C from the inlet **30***a* of the downstream water conduit **30**, and the flow is uniformly adjusted while maintaining the water momentum. Therefore the cleaning water is suppressed from spreading out left and right from the exit **30***b* of the downstream water conduit **30**, and linearly flows along the actual center line F.

As indicated at an arrow F**7**, the cleaning water flows along the inner wall surface **38** in the right side (one side) of the downstream water conduit **30**. As indicated at an arrow F**8**, the cleaning water flowing along the inner wall surface **38** flows along the inner wall surface **38** to the downstream end portion **38***b* positioned in the left side (the other side) to the center line C of the toilet main body **2**. Since the cleaning water flowing along the inner wall surface **38** flows to the left region over the center line C once, for example, in a case where the water momentum of the cleaning water supplied to the supply opening **6** of the toilet main body **2** from the storage tank **4** in the first half and the middle of a toilet cleaning operation is relatively strong, the cleaning water flowing out from the vicinity of the downstream end portion **38***b* is hard to flow toward the center rear region **20***b* of the rim water passage **20** in the vicinity of the center line C. Therefore the cleaning water flowing out from the vicinity of the downstream end portion **38***b* of the inner wall surface **38** is suppressed from flowing down to spread out toward a region of the vicinity of the center line C of the waste receiving surface **16**, and, as indicated at an arrow F**9**, can form a linear main flow of the cleaning water toward the rim water passage **20** on an extension line of the inner wall surface **38** from the downstream water conduit **30**.

Since the width of the downstream water conduit **30** is smaller than the width of the upstream water conduit **28**, the flow velocity of the cleaning water flowing from the upstream water conduit **28** to the downstream water conduit **30** increases in the downstream water conduit **30**. Therefore as indicated at the arrows F**4** and F**9**, the cleaning water flowing out from the vicinity of the downstream end portion **38***b* of the inner wall surface **38** increases in flow velocity and water momentum. Accordingly the cleaning water is further suppressed from flowing to spread out in the region of the vicinity of the center line C, in the center rear region **20***b* and in the region of the vicinity of the center line C of the waste receiving surface **16**, and it is possible to form the main flow of the cleaning water toward the rim water passage **20** from the downstream water conduit **30**, and more excellently form the swirl flow of the cleaning water to swirl in the rim water passage **20**.

As indicated at arrows F**10** and F**11** in FIG. **2**, the cleaning water flowing out from the exit **30***b* of the downstream water conduit **30** flows around on the rim water passage **20**. Since the amount of the cleaning water flowing down in the region of the vicinity of the center line C of the waste receiving surface **16** from the center rear region **20***b* is reduced, the flow amount per unit time toward the swirling direction of the cleaning water increases. A great part of the cleaning

water forms the main flow of the swirl flow flowing on the rim water passage bottom surface **24** in the rim water passage **20**.

The cleaning water forms this swirl flow, gradually flows down from the slit aperture **26** formed in the inside of the rim water passage bottom surface **24**, and, as indicated at an arrow F**12**, uniformly cleans the entirety of the waste receiving surface **16** of the bowl **8**. The cleaning water flowing down in the bowl **8** is discharged from the discharge trap conduit **14** together with wastes to end a series of cleaning operations of the toilet main body **2**.

The flush toilet **1** according to the first embodiment of the present invention is provided with the bilaterally non-symmetric water conduit **10**, but not limited thereto, may adopt a water conduit in a bilaterally reversed shape. In this case, the cleaning water flowing on the rim water passage forms the swirl flow in a clockwise direction. A flush toilet **101** according to a second embodiment and a flush toilet **201** according to a third embodiment as well may adopt the flow passage structure in a similar shape.

According to the flush toilet **1** by the first embodiment of the present invention as described above, the cleaning water turns from the upstream water conduit **28** extending to the right side of the toilet main body **2**, flows into the downstream water conduit **30**, and is introduced to the left side along the downstream water conduit **30**. The cleaning water flowing along the inner wall surface **38** on the right side of the downstream water conduit **30** in the cleaning water introduced to the left side can flow along the inner wall surface **38** to the downstream end portion **38***b* positioned in the left side to the center line C of the toilet main body **2**. Accordingly the cleaning water flowing out from the vicinity of the downstream end portion **38***b* of the inner wall surface **38** can be suppressed from flowing down in the region of the vicinity of the center line C and can form the main flow of the cleaning water toward the rim water passage **20** from the downstream water conduit **30**. Therefore in the so-called open rim type flush toilet having the aperture formed on the entire circumference of the rim **18**, it is possible to form the excellent swirl flow of the cleaning water to swirl in the rim water passage **20**, and even in a case where the cleaning water amount to be used for toilet cleaning is set to be small, the bowl **8** can be sufficiently cleaned by the swirl flow.

According to the flush toilet **1** by the first embodiment of the present invention, the flow velocity of the cleaning water flowing into the downstream water conduit **30** from the upstream water conduit **28** increases in the downstream water conduit **30**, and the cleaning water flowing out from the vicinity of the downstream end portion **38***b* of the inner wall surface **38** is further suppressed from flowing to spread out to the region in the vicinity of the center line C. In addition, the main flow of the cleaning water toward the rim water passage **20** from the downstream water conduit **30** can be formed, and more excellently it is possible to form the swirl flow of the cleaning water to swirl in the rim water passage **20**.

Further, according to the flush toilet **1** by the first embodiment of the present invention, since the center line A**1** of the upstream water conduit **28** extending to the right side of the toilet main body **2** extends to be biased in the right side to the center point c**1** of the supply opening **6**, the cleaning water flowing out from the supply opening **6** can relatively smoothly flow out to the biased upstream water conduit **28** from the right side to the center point c**1** of the supply opening **6**. Therefore as compared to a case where the center line A**1** of the upstream water conduit **28** is not biased from the center point c**1** of the supply opening **6**, the cleaning water can relatively smoothly flow into the upstream water conduit **28** from a side of the upstream water conduit **28**.

According to the flush toilet **1** by the first embodiment of the present invention, since the curvature radius r**1** of the outer circumference wall **32***a* of the flow passage in the bending portion **32** is smaller than the curvature radius r**2** of the inner circumference wall **32***b* of the flow passage in the bending portion **32**, the flow along the outer circumference wall **32***a* of the flow passage in the bending portion **32** can be guided toward the flow along the inner circumference wall **32***b* of the flow passage in the bending portion **32**, and the momentum of the cleaning water flowing into the rim water passage **20** along the outer wall surface **30***c* extending from the inner circumference wall **32***b*-side to the downstream water conduit **30** is strengthened, making it easier to form the flow to swirl in the rim water passage **20**.

Next, an explanation will be made of a flush toilet according to a second embodiment of the present invention with reference to FIG. **4**. In the flush toilet according to the second embodiment, components identical to those in the first embodiment as described above are designated by identical reference numerals, and the explanation is omitted.

A flush toilet **101** according to the second embodiment of the present invention has a toilet main body **102** formed of a pottery and the like.

A water conduit **110** is formed between the supply opening **6** and the rim water passage **20** on a rear upper portion of the toilet main body **102** to introduce the cleaning water supplied from a storage tank (unillustrated) from the supply opening **6** to the bowl **8**.

In the second embodiment, only the configuration that a width of a downstream water conduit **130** of the water conduit **110** is made smaller from an inlet to an exit of the downstream water conduit **130** differs from a shape of the downstream water conduit **30** of the water conduit **10** in the flush toilet **1** of the first embodiment.

Next, an explanation will be in detail made of the downstream water conduit **130** of the water conduit **110**.

As illustrated in FIG. **4**, the downstream water conduit **130** forms a flow passage that extends to the left side from a downstream water conduit inlet **130***a* connected to the bending portion **32**, and leads to a downstream water conduit exit **130***b* connected to the merging portion **20***a* of the rim water passage **20**.

The downstream water conduit **130** has the inlet **130***a* arranged in the right region to the center line C, an intermediate portion **130***d* arranged in the central vicinity region of the vicinity of the center line C, and further, the exit **130***b* arranged in the left region in the left side to the center line C.

In the second embodiment, an inner wall surface **138** in the right side of the downstream water conduit **130** extends to the left side to the center line C from the right side to the center line C of the toilet main body **102**.

The inner wall surface **138** forms an upstream end portion **138***a* that forms the inlet **130***a* and is connected to the downstream end portion **32***c* of the outer circumference wall **32***a* and a downstream end portion **138***b* that forms the exit **130***b* and is positioned in the left side to the center line C. Therefore the inner wall surface **138** extends over the center line C from the right side to the left side of the center line C.

The downstream end portion **138***b* of the inner wall surface **138** in the downstream water conduit **130** forms a convex portion projecting into a region of the left side to the center line C. The downstream end portion **138***b* of the inner wall surface **138** is connected to the rim water passage outer

wall surface **34** extending from the rear side of the waste receiving surface **16** in the region of the left side to the center line C.

Since the downstream end portion **138***b* forms the convex portion projecting into the region of the left side to the center line C, the downstream end portion **138***b* sections the flow passage of the downstream water conduit **130** from the center rear region **20***b* of the rim water passage **20** on the center line C.

In the second embodiment as well, the inner wall surface **138** of the downstream water conduit **130** is formed to move the virtual inner wall surface **42** closer to the virtual center line E of the virtual downstream conduit **40**, for example, by parallel movement, as similar to the first embodiment.

In the second embodiment of the present invention, which is different from the first embodiment, the width of the downstream water conduit **130** is smaller toward the intermediate portion **130***d* and the exit **130***b* from the inlet **130***a* of the downstream water conduit **130**. Therefore there is a relation of width W**4** of the inlet **130***a*>width W**5** of the intermediate portion **130***d*>width W**6** of the exit **130***b*. Here, since a distance from the virtual center line E to the outer wall surface **30***c* is constant, a distance from the virtual center line E to the inner wall surface **138** is smaller toward the intermediate portion **130***d* and the exit **130***b* from the inlet **130***a*.

The second embodiment also includes the structure that satisfies a relation of width W**4** of the inlet **130***a*>width W**6** of the exit **130***b* of the downstream water conduit **130**. In addition, the second embodiment includes the structure that satisfies a relation of width W**5** of the intermediate portion **130***d*>width W**6** of the exit **130***b* of the downstream water conduit **130**. For example, the width of the downstream water conduit **130** is made smaller in a substantially constant rate from the inlet **130***a* toward the exit **130***b*. When the width of the downstream water conduit **130** has the relation as described above, the width of the downstream water conduit **130** may non-linearly change without changing in a substantially constant rate from the inlet **130***a* toward the exit **130***b*.

The inner wall surface **138** is formed to be slightly inclined such that the downstream side is closer to the virtual center line E. The width of the downstream water conduit **130** in the second embodiment, for example, the width W**4** of the inlet **130***a* is smaller than the width W**2** of the upstream water conduit **28**. The width W**4** of the inlet **130***a* of the downstream water conduit **130** is smaller than, and approximately three-fourths of, the width W**3** of the virtual downstream conduit **40** (refer to FIG. **3** because of omission in illustration of the virtual downstream conduit **40** in FIG. **4**). Accordingly a distance **15** from the virtual center line E for connection between the point of the upstream water conduit **28** on the center line A**1** and the intersection point C**2** to the inner wall surface **138** is shorter than a distance **16** from the virtual center line E to the outer wall surface **30***c*. In addition, a distance **17** from the intersection point C**2** to the inner wall surface **138** is shorter than a distance **18** from the intersection point C**2** to the outer wall surface **30***c*.

As describe above, since the width of the downstream water conduit **130** is made smaller from the inlet **130***a* to the exit **130***b* and a cross-section area of the flow passage is also reduced, the flow velocity and water momentum of the cleaning water flowing into the downstream water conduit increase from the inlet **130***a* toward the exit **130***b* in the downstream water conduit. Therefore the cleaning water flowing out from the vicinity of the exit **130***b* increases in flow velocity and water momentum. Accordingly the cleaning water is further suppressed from flowing to spread out to the region in the vicinity of the center line C, for example, the center rear region **20***b* and the region in the vicinity of the center line C of the waste receiving surface **16** and the main flow of the cleaning water toward the rim water passage **20** from the downstream water conduit **130** can be formed, and more excellently it is possible to form the swirl flow of the cleaning water to swirl in the rim water passage **20**.

Next, an explanation will be made of a flush toilet according to a third embodiment of the present invention with reference to FIG. **5**. In the third embodiment, components identical to those in the first embodiment as described above are designated by identical reference numerals, and the explanation is omitted.

A flush toilet **201** according to the third embodiment of the present invention has a toilet main body **202** formed of a pottery and the like.

In the toilet main body **202**, a water conduit **210** is formed between the supply opening **6** and the rim water passage **20** to introduce the cleaning water supplied from the storage tank (unillustrated) from the supply opening **6** to the bowl **8**.

In the third embodiment, only the configuration that a shape of a downstream water conduit **230** of the water conduit **210** is formed such that a width of the downstream water conduit **230** is larger from an inlet to an exit of the downstream water conduit **230** differs from the shape of the downstream water conduit **30** of the water conduit **10** of the first embodiment.

Next, an explanation will be in detail made of the downstream water conduit **230**. As illustrated in FIG. **5**, the downstream water conduit **230** forms a flow passage that extends to the left side from an inlet **230***a* connected to the bending portion **32** and leads to an exit **230***b* connected to the merging portion **20***a* of the rim water passage **20**.

The downstream water conduit **230** has the inlet **230***a* arranged in the right region in the right side to the center line C, an intermediate portion **230***d* arranged in the central vicinity region of the vicinity of the center line C, and further, the exit **230***b* arranged in the left region in the left side to the center line C.

In the third embodiment, an inner wall surface **238** in the right side of the downstream water conduit **230** extends to the left region to the center line C from the right side to the center line C of the toilet main body **202**.

The inner wall surface **238** forms an upstream end portion **238***a* that forms the inlet **230***a* of the downstream water conduit **230** and is connected to the downstream end portion **32***c* of the outer circumference wall **32***a*, and a downstream end portion **238***b* that forms a downstream water conduit exit **230***b* and is positioned in the left side to the center line C. Therefore the inner wall surface **238** extends over the center line C from the right side to the left side of the center line C.

The downstream end portion **238***b* of the inner wall surface **238** in the downstream water conduit **230** forms a convex portion projecting into a region of the left side to the center line C. The downstream end portion **238***b* of the inner wall surface **238** is connected to the rim water passage outer wall surface **34** extending from the rear side of the waste receiving surface **16** in the region of the left side to the center line C.

Since the downstream end portion **238***b* forms the convex portion projecting in the left side to the center line C, the downstream end portion **238***b* sections the flow passage of the downstream water conduit **230** from the center rear region **20***b* of the rim water passage **20** on the center line C.

In the third embodiment as well, the inner wall surface **238** of the downstream water conduit **230** is formed to move the virtual inner wall surface **42** (refer to FIG. **3**) closer to the virtual center line E of the virtual downstream conduit **40** in the virtual form (refer to FIG. **3**) as similar to the first embodiment, for example, by parallel movement.

In the third embodiment of the present invention, which is different from the first embodiment, the width of the downstream water conduit **230** is made larger toward the intermediate portion **230***d* and the exit **230***b* from the inlet **230***a*. Therefore there is a relation of width W**7** of the inlet **230***a*<width W**8** of the intermediate portion **230***d*<width W**9** of the exit **230***b* of the downstream water conduit **230**. Here, since a distance from the virtual center line E to the outer wall surface **30***c* is constant, a distance from the virtual center line E to the inner wall surface **238** is made larger toward the intermediate portion **230***d* and the exit **230***b* from the inlet **230***a*.

The third embodiment also includes the structure that satisfies a relation of width W**7** of the inlet **230***a*<width W**9** of the exit **230***b* of the downstream water conduit **230**. In addition, the third embodiment includes the structure that satisfies a relation of width W**8** of the intermediate portion **230***d*<width W**9** of the exit **230***b*. For example, the width of the downstream water conduit **230** is made small in a substantially constant rate from the inlet **230***a* toward the exit **230***b*. When the width of the downstream water conduit **230** has the relation as described above, the width of the downstream water conduit **230** may non-linearly change without changing in a substantially constant rate from the downstream water conduit inlet **230***a* toward the downstream water conduit exit **230***b*.

The inner wall surface **238** is formed to be slightly inclined such that the downstream side is separated from the virtual center line E. The width W**7** of the downstream water conduit **230** in the present embodiment is smaller than the width W**2** of the upstream water conduit **28**. For example, even the width W**9** of the exit **230***b* of the downstream water conduit **230** is smaller than the width W**2** of the upstream water conduit **28**. The width W**7** of the inlet **230***a* is smaller than, and approximately three-fourths of, the width W**3** of the virtual downstream conduit **40** (refer to FIG. **3** because of omission in illustration of the virtual downstream conduit **40** in FIG. **5**). Accordingly a distance **19** from the virtual center line E for connection between the point of the upstream water conduit **28** on the center line A**1** and the intersection point C**2** to the inner wall surface **238** is shorter than a distance **110** from the virtual center line E to the outer wall surface **30***c*. In addition, a distance **111** from the intersection point C**2** to the inner wall surface **238** is shorter than a distance **112** from the intersection point C**2** to the outer wall surface **30***c*.

As describe above, since the width of the downstream water conduit **230** is made wider toward the exit **230***b* from the inlet **230***a*, in a case where the water momentum of the cleaning water to be supplied to the toilet main body **202** from the storage tank **4** is made weaker in the latter half of a toilet cleaning operation (or timing immediately before end of the toilet cleaning operation), as indicated at an arrow F**13** the cleaning water flowing into the downstream water conduit **230** can form the flow to widen from the inlet **230***a* toward the exit **230***b* by a relatively gradual momentum and a relatively slow flow velocity of the cleaning water. Accordingly the cleaning water flowing out from the exit **230***b* of the downstream water conduit **230** can form the flow spreading out in a fan shape corresponding to the widening of the width of the downstream water conduit **230**, and flows to spread out in a wide range of the bowl along with the flow with reduced flow velocity and water momentum swirling on the rim water passage **20** and returning back to the center rear region **20***b*, making it possible to clean a wide range of the bowl more uniformly.

On the other hand, in a case where the water momentum of the cleaning water supplied to the supply opening **6** of the toilet main body **202** from the storage tank **4** in the first half and in the middle of the toilet cleaning operation is relatively strong, as indicated at an arrow F**14** the cleaning water flowing in the downstream water conduit **230** can form a flow having directivity linearly oriented toward the rim water passage **20** from the downstream water conduit **230** as described above along the flow passage of the downstream water conduit **230** linearly extending in a predetermined length, the outer wall surface **30***c* and the like.

According to the flush toilet **201** of the third embodiment in the present invention as described above, since the width of the downstream water conduit **230** is made larger toward the exit **230***b* from the inlet **230***a*, in a case where the water momentum of the cleaning water to be supplied to the supply opening **6** of the toilet main body **202** from the storage tank **4** is made weaker in the latter half of the toilet cleaning operation, the cleaning water flowing out from the exit **230***b* can form the flow spreading out in a fan shape corresponding to the widening of the width of the downstream water conduit **230** to clean a wide range of the bowl **8** more uniformly.

Next, an explanation will be made of a fourth embodiment of the present invention with reference to FIG. **6**. In the fourth embodiment, components identical to those in the first embodiment as described above are designated by identical reference numerals, and the explanation is omitted.

A flush toilet **301** according to the fourth embodiment of the present invention has a toilet main body **302** formed of a pottery and the like.

An upper edge portion of a bowl **308** of the toilet main body **302** is provided with a rim **318** overhung inside, a first spout opening **339** and a second spout opening **341** formed on a rim water passage **320**, and the cleaning water to be supplied from a water conduit **310** formed in the inside of the rear side of the toilet main body **302** is spouted from the first spout opening **339** and the second spout opening **341**.

In the fourth embodiment, a rim, which is different from the open rim type form according to the first to third embodiments, is a rim **318** of a so-called non-brim type. The flush toilet **301** having the rim **318** of the non-brim type spouts the cleaning water on the rim **318** from the first spout opening **339** and the second spout opening **341** to form a swirl flow swirling on the waste receiving surface **16**. The flush toilet **301** according to the fourth embodiment may have only the first spout opening **339**, and the first spout opening **339** arranged on an extension of the flow passage of the water conduit **310** may be arranged in any location of an entire circumference of the rim.

The cleaning water spouted from the first spout opening **339** flows on the rim water passage bottom surface (shelf surface) **324** in the rim water passage **320** to swirl on an upper portion of the bowl **308**, and flows down on the waste receiving surface **16** from the rim water passage bottom surface **324** while swirling to clean the bowl **308**. The cleaning water spouted from the second spout opening **341** flows on the rim water passage bottom surface **324** in the rim water passage **320** to swirl on an upper portion of the bowl **308**, and flows down on the waste receiving surface **16** from the rim water passage bottom surface **324** while swirling to clean the bowl **308**.

In the present embodiment, the rim **318** overhangs inside, but may have a longitudinal wall-shaped form extending substantially vertically.

The rim **318** is formed in the inside of a substantially entire circumference or a large part of the upper edge portion of the bowl **308**, making it possible to introduce the cleaning water. The rim **318** is positioned on an upper side of the waste receiving surface **16**, and an upper portion of a rim water passage outer wall surface **334** as the inner wall surface is formed to project toward the inside. The rim **318** is formed such that the rim water passage bottom surface **324** of the rim **318** extends horizontally toward the inside. Therefore the rim **318** forms the rim water passage **320** on the rim water passage bottom surface **324**. The inside and lower side of the rim water passage **320** formed along the circumferential direction of the rim **318** open over the entire circumference, and the waste receiving surface **16** of the bowl **308** is formed.

The rim water passage bottom surface **324** forms the shelf-shaped rim water passage bottom surface **324** formed over a substantially entire circumference of the bowl **308**. The rim water passage bottom surface **324** forms a flat surface annularly formed on the upper portion of the bowl **308**, and the flat surface is substantially horizontally formed from an outer direction to an inner direction of the bowl **308**. With this configuration, the cleaning water supplied from the water conduit **310** can form the flow going around on the upper portion of the bowl **308** while flowing on the rim water passage bottom surface **324** in the rim water passage **320**.

The water conduit **310** is provided with the supply opening **6**, the upstream water conduit **28** that is formed between the first spout opening **339** and the second spout opening **341** and extends from the vicinity of the supply opening **6** to the right side of the toilet main body **302**, and a downstream water conduit **330** extending to the left side from the upstream water conduit **28**.

The downstream water conduit **330** in the fourth embodiment of the present invention has the structure and function as similar to those of the downstream water conduit **30** in the first embodiment of the present invention. However, a point where the exit **330***b* of the downstream water conduit **330** is communicated with the first spout opening **339** and a downstream branched water passage **342** branched from the exit **330***b* extends to the second spout opening **341** differs from the downstream water conduit **30** in the first embodiment of the present invention.

Next, an explanation will be in detail made of the downstream water conduit **330**. As illustrated in FIG. **6**, the downstream water conduit **330** forms a flow passage that extends to the left side from an inlet **330***a* connected to the bending portion **32** and leads to an exit **330***b* connected to the rim water passage **320**.

The downstream water conduit **330** has the inlet **330***a* arranged in the right region to the center line C, an intermediate portion **330***d* arranged in the central vicinity region of the vicinity of the center line C, and further, the exit **330***b* arranged in the left region to the center line C.

In the fourth embodiment, an inner wall surface **338** of the downstream water conduit **330** in the right side extends to the left region to the center line C from the right side to the center line C of the toilet main body **302**.

The inner wall surface **338** forms an upstream end portion **338***a* that forms the inlet **330***a* of the downstream water conduit **330** and is connected to the outer circumference wall **32***a*, and a downstream end portion **338***b* that forms the exit **330***b* and is positioned in the left side to the center line C. Therefore the inner wall surface **338** extends over the center line C from the right side to the left side of the center line C.

In the fourth embodiment as well, the inner wall surface **338** of the downstream water conduit **330** of the present embodiment is formed to move the virtual inner wall surface **42** closer to the virtual center line E of the virtual downstream conduit **40** in the virtual form as similar to the first embodiment, for example, by parallel movement.

Next, an explanation will be made of a function (operation) of the flush toilet according to the fourth embodiment of the present invention with reference to FIG. **6**.

In the fourth embodiment of the present invention, the cleaning water flowing into the water conduit **310** flows toward the right side of the toilet main body **302** in the upstream water conduit **28**. That is, the cleaning water flows toward the right side to be away from the center line C. When the cleaning water reaches the exit **28***a* of the upstream water conduit **28**, the cleaning water turns in the bending portion **32**.

Subsequently the cleaning water flows into the downstream water conduit **330** extending toward the left front side at the opposite side. The cleaning water forms a linear flow from the inlet **330***a* toward the first spout opening **339** along the downstream water conduit **330** linearly extending.

Since the structure of the downstream water conduit **330** in the fourth embodiment is substantially similar to the structure of the downstream water conduit **30** in the first embodiment, the flow of the cleaning water in the downstream water conduit **330** in the fourth embodiment is substantially similar to the flow of the cleaning water in the downstream water conduit **30** in the first embodiment.

Also in the fourth embodiment, the cleaning water introduced to the successive inner wall surface **338** from the outer circumference wall **32***a* flows along the inner wall surface **338** in the right side of the downstream water conduit **330**. The cleaning water flowing along the inner wall surface **338** can flow along the inner wall surface **338** to the downstream end portion **338***b* positioned in the left side to the center line C of the toilet main body **302**. The cleaning water flowing out from the vicinity of the downstream end portion **338***b* of the inner wall surface **338** can linearly form a main flow of the cleaning water toward the rim water passage **320** on the extension line of the inner wall surface **338** from the downstream water conduit **330**.

The cleaning water passing the downstream water conduit **330** linearly flows over the center line C, and the direction of the flow is adjusted relatively uniformly while maintaining the water momentum. Accordingly the cleaning water can be suppressed from spreading out in the left and right from the first spout opening **339** to linearly flow along a flow line A**4** to a flow line A**5**.

On the other hand, a part of the cleaning water flows to be branched from the downstream water conduit **330** to a downstream branched water passage **342**, and after linearly flowing along the downstream branched water passage **342**, is spouted from the second spout opening **341** on the rim water passage bottom surface **324**.

The cleaning water flowing out from the first spout opening **339** flows in the rim water passage **320** along the flow line A**5** of the cleaning water to go around on the rim water passage **320**. A flow amount per unit time of the cleaning water toward the swirling direction increases. The flow velocity and water momentum of the cleaning water at the time of flowing out toward the rim water passage **320** from the first spout opening **339** are strengthened, and even in a case of adopting the rim other than the open rim (for

example, non-brim type rim), the flow to swirl in the rim water passage **320** tends to be easily formed.

The cleaning water from the second spout opening **341** flows in the rim water passage **320** along the flow line A**6** of the cleaning water to go around on the rim water passage **320**. A flow amount per unit time of the cleaning water toward the swirling direction increases. The flow velocity and water momentum of the cleaning water at the time of flowing into toward the rim water passage **320** from the second spout opening **341** are strengthened, and even in a case of adopting the rim other than the open rim (for example, non-brim type rim), the flow to swirl in the rim water passage **320** tends to be easily formed.

In this way, the cleaning water flows on the rim water passage bottom surface **324** in the rim water passage **320** to form the swirl flow in a counterclockwise direction. The cleaning water forms this swirl flow, and gradually flows down on the waste receiving surface **16** of the bowl **308** in the inside of the rim water passage bottom surface **324** to uniformly clean the entirety of the bowl **308**. The cleaning water flowing down in the bowl **308** is discharged from the discharge trap conduit **14** together with wastes to end a series of cleaning operations of the toilet main body **302**.

According to the flush toilet **301** by the fourth embodiment of the present invention as described above, the cleaning water turns from the upstream water conduit **28** extending to the right side of the toilet main body **302**, flows into the downstream water conduit **330**, and is introduced to the left side along the downstream water conduit **330**. The cleaning water flowing along the inner wall surface **338** on the right side of the downstream water conduit **330** in the cleaning water introduced to the left side from the right side can flow along the inner wall surface **338** to the downstream end portion **338***b* positioned in the left side to the center line C of the toilet main body **302**. Accordingly the cleaning water flowing out from the vicinity of the downstream end portion **338***b* of the inner wall surface **338** can form the main flow of the cleaning water toward the first spout opening **339** and the second spout opening **341** from the downstream water conduit **330**. Therefore in the so-called non-brim type flush toilet, the cleaning water spouted from the first spout opening **339** and the second spout opening **341** can form the excellent swirl flow of the cleaning water to swirl on the waste receiving surface **16**, and even in a case where the cleaning water amount to be used for toilet cleaning is set to be small, the bowl **308** can be sufficiently cleaned by the swirl flow.

Next, an explanation will be made of a flush toilet according to a fifth embodiment of the present invention with reference to FIG. **7** and FIG. **8**. In the flush toilet according to the fifth embodiment, components identical to those in the first embodiment as described above are designated by identical reference numerals, and the explanation is omitted.

As illustrated in FIG. **7** and FIG. **8**, a flush toilet **501** according to the fifth embodiment of the present invention has a storage tank **504** for storing cleaning water. The storage tank **504** includes a tank main body **544** for storing cleaning water, a discharge opening **546** provided on a bottom portion **544***a* of the tank main body **544**, a discharge valve device **548** that opens/closes the discharge opening **546**, and a cylindrical cleaning water guiding member **552** that is attached on the discharge opening **546** and guides the cleaning water to the supply opening **6** of the toilet main body **2**.

The discharge valve device **548** is a so-called direct-driven type discharge valve device, and is provided with a discharge valve body **550** that is formed to be movable in the upper-lower direction in the storage tank **504**. In the discharge valve device **548**, the discharge opening **546** opens/closes by an upper/lower movement of the discharge valve body **550** caused by an operation of an operating lever (unillustrated) provided in the storage tank **504**.

The cleaning water guiding member **552** forms a guiding flow passage **554** that is a flow passage that guides the cleaning water to the supply opening **6** of the toilet main body **2** from the discharge opening **546** of the storage tank **504**.

The cleaning water guiding member **552** is provided with a narrowed portion **556** that projects to the guiding flow passage **554** from a part of the inner wall.

The narrowed portion **556** is a semicircular plate member projecting in a direction of the upstream water conduit **28** of the water conduit **10** as described above. The guiding flow passage **554** in a location where the narrowed portion **556** is provided is narrowed by an area where the narrowed portion **556** exists toward the extension direction of the upstream water conduit **28**.

The cleaning water supplied to the supply opening **6** tends to easily flow toward the upstream water conduit **28** by the narrowed portion **556** of the cleaning water guiding member **552**.

In the flush toilet **501** of the fifth embodiment, the narrowed portion **556** of the cleaning water guiding member **552** is formed in the semicircular shape, but may be formed as a modification illustrated in FIG. **9** and FIG. **10**. In this modification, a narrowed portion **558** is provided to project in the inside of the guiding flow passage **554** from an entire circumference of the inner wall of the cleaning water guiding member **552**, and is formed in such a shape as to bore a small circular hole from a large circular form. In the narrowed portion **558** as well, the guiding flow passage **554** in a location where the narrowed portion **558** is provided is narrowed by an area where the narrowed portion **558** exists toward the extension direction of the upstream water conduit **28**. The cleaning water supplied to the supply opening **6** tends to easily flow toward the upstream water conduit **28** by the narrowed portion **558** of the cleaning water guiding member **552**.

Next, an explanation will be made of a function (operation) of the flush toilet **501** according to the fifth embodiment of the present invention with reference to FIG. **7** to FIG. **10**.

In the fifth embodiment of the present invention, the discharge valve body **550** of the storage tank **504** operates by an operation of an operating lever (unillustrated) provided in the storage tank **504** to open the discharge opening **546**, and the cleaning water flows into the cleaning water guiding member **552**. The cleaning water having flown in flows along the guiding flow passage **554** of the cleaning water guiding member **552**, and flows out into the supply opening **6** of the toilet main body **2**.

At this time, since the guiding flow passage **554** of the cleaning water guiding member **552** is narrowed such that the cleaning water flows in an extension direction of the upstream water conduit **28** by the narrowed portions **556**, **558**, when the cleaning water flows in the guiding flow passage **554** along the narrowed portions **556**, **558**, the cleaning water flowing in the guiding flow passage **554** is guided in the extension direction of the upstream water conduit **28**, and tends to easily flow in the extension direction of the upstream water conduit **28**.

Therefore it is possible to produce the flow of the cleaning water toward the extension direction of the upstream water

conduit **28**, and more excellently form the swirl flow of the cleaning water to swirl in the rim water passage **20**.

What is claimed is:

1. A flush toilet that cleans a bowl by cleaning water, comprising:

a toilet main body; and

a water supply device that supplies the cleaning water to a supply opening of the toilet main body;

the toilet main body including:

a bowl having a waste receiving surface having a bowl shape, a rim provided on an upper side of the waste receiving surface, a rim water passage formed on an entire circumference of the rim to introduce the cleaning water, and an aperture formed on the entire circumference of the rim to supply the cleaning water on the waste receiving surface from the rim water passage;

a discharge passage an inlet of which is connected to a lower side of the bowl to discharge wastes; and

a water conduit formed between the supply opening and the rim water passage to introduce the cleaning water to the rim water passage,

wherein the water conduit includes an upstream water conduit extending from the supply opening to one side from a center line of the toilet main body, the center line being positioned from a front end to a rear end of the toilet main body and at a center in a left-right direction of the toilet main body, and a downstream water conduit extending from the upstream water conduit to the other side from the center line of the toilet main body,

the upstream water conduit is formed such that an entire downstream end of an inner wall surface of the upstream water conduit is positioned in the one side from the center line of the toilet main body, and

the downstream water conduit is formed such that an entire downstream end of an inner wall surface of the downstream water conduit is positioned in the other side from the center line of the toilet main body.

2. The flush toilet according to claim **1**, wherein a width of the downstream water conduit is smaller than a width of the upstream water conduit.

3. The flush toilet according to claim **1**, wherein a width of the downstream water conduit is made smaller toward an exit of the downstream water conduit from an inlet of the downstream water conduit.

4. The flush toilet according to claim **1**, wherein a width of the downstream water conduit is made larger toward an exit of the downstream water conduit from an inlet of the downstream water conduit.

5. The flush toilet according to claim **1**, wherein a center line of the upstream water conduit extends to be biased to one side in the left-right direction from a center of the supply opening.

6. The flush toilet according to claim **1**, wherein the water conduit further includes a bending portion formed between an exit of the upstream water conduit and an inlet of the downstream water conduit, wherein the bending portion is formed such that a curvature radius of an outer circumference wall of a flow passage in the bending portion is smaller than a curvature radius of an inner circumference wall of the flow passage.

7. The flush toilet according to claim **1**, wherein the water supply device is a storage tank that stores cleaning water, wherein a bottom portion of the storage tank is provided with a discharge opening that supplies the cleaning water to the supply opening of the toilet main body, and the discharge opening of the storage tank is provided with a guiding device that guides the cleaning water to be supplied to the supply opening of the toilet main body to an extension direction of the upstream water conduit.

8. The flush toilet according to claim **7**, wherein the guiding device is a cylindrical guiding member for connection between the discharge opening and the supply opening, wherein the guiding member is provided with a narrowed portion projecting inside from a part of or an entire circumference of an inner wall of the guiding member such that the cleaning water supplied to the supply opening flows to the extension direction of the upstream water conduit.

9. A flush toilet that cleans a bowl by cleaning water, comprising:

a toilet main body; and

a water supply device that supplies the cleaning water to a supply opening of a toilet main body;

the toilet main body including a bowl having a waste receiving surface having a bowl shape, a rim provided on an upper edge portion of the bowl, a rim water passage formed on an inner circumference of the rim to introduce the cleaning water, and a spout portion opening on the rim water passage and spouting the cleaning water to the rim water passage;

a discharge passage connected to a lower side of the bowl to discharge wastes; and

a water conduit formed between the supply opening and the spout portion to introduce the cleaning water to the spout portion,

wherein the water conduit includes an upstream water conduit extending from the supply opening to one side from a center line of the toilet main body, the center line being positioned from a front end to a rear end of the toilet main body and at a center in a left-right direction of the toilet main body, and a downstream water conduit extending from the upstream water conduit to the other side from the center line of the toilet main body,

the upstream water conduit is formed such that an entire downstream end of an inner wall surface of the upstream water conduit is positioned in the one side from the center line of the toilet main body, and

the downstream water conduit is formed such that an entire downstream end of an inner wall surface of the downstream water conduit is positioned in the other side from the center line of the toilet main body.

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